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Date of issue of this number, August 26, 1915.

LARGEST TREE FOUND BY THIS ASSOCIATION

Sycamore, buttonwood or plane tree (*Platanus occidentalis*) near Worthington, Ind., by a big margin the largest tree submitted in response to the American Genetic Association's offer of prizes for photographs. It is 42 feet 3 inches in circumference and about 140 feet high. Barring conifers, among which the California Sequoias defy competition, the sycamore probably reaches a larger size than any other tree in North America; and although reports of bigger trees are from time to time made, this association has been unable to get authentic record of any specimen which equals the Worthington tree in size. Its age is unknown, but "oldest inhabitants" declare it has not increased perceptibly in size in the last sixty years. (Frontispiece.)

[See "Photographs of Large Trees," p. 407.]

COLOR IN COCKER SPANIELS

Study of Eighty-nine Matings Shows Numerous Correlations in Color and Indicates That Inheritance Is Along Same Lines as in Pointer Dogs—Analogies in Other Breeds

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ONE of the few serious pieces of research work on the inheritance of coat color in dogs is that reported in this journal last year by C. C. Little. He showed[1] that in Pointers, black, brown (liver), and yellow (lemon, orange and tan) are inherited in true Mendelian fashion, segregation showing the colors to be due to two factors.

Little's data were from the American Kennel Club records. The authors of this article have utilized private records,[2] comprising eighty-nine matings; in each case the record includes the names and colors of the grandparents, parents and offspring. With this material, we tested Little's conclusions, to see to what extent, if any, they hold good for Cocker Spaniel dogs.

It is, perhaps, worth emphasizing that our records include every pup born in a litter, whether these dogs were later registered or not. Dogs are included here that are in some cases considered undesirable from the breeders standpoint, and would not ordinarily be shown or recorded. To the genetist, this is naturally a distinct advantage, and makes private records rather more trustworthy than stud- or herd-book records on which most investigators are obliged to rely. And as we were personally acquainted with the owners of the dogs, we were able to take every possible precaution to ensure accuracy in the records and descriptions of the colors. For these reasons we feel that, although the total number of matings studied is not large, the results are worthy of confidence.

The colors of Cocker Spaniels are ordinarily spoken of as blacks, livers, reds, and lemons, the reds and lemons corresponding to the yellow colors of Pointers. It is well known that livers may occur in two shades, one a dark chestnut, the other a lighter, more faded liver color. The reds vary from mahogany to lemon, through the red and orange shades. The colors known as lemons are difficult to distinguish from the reds, in fact a good many reds are registered in the Kennel Records as lemon, and some lemons as red. The lemon color may be a brilliant lemon or dull buff, almost without lustre. In distinguishing red and lemon the final test is the color of the offspring when the doubtful animal is mated with a recognized lemon. As a rule a lemon pup is cream or white at birth, and becomes darker with age, while a red shows considerable color at birth.

Our method in attempting to determine whether or not the scheme suggested by Little would hold for Cocker Spaniels was as follows: a table was constructed to show what results might be expected when a dog of any color type was crossed with a bitch of any color type. This arrangement is re-

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[1] Coat Color in Pointer Dogs, Journal of Heredity, Vol. V, no. 6, pp. 244–248; June, 1914.

[2] The largest number of records are from the Scioto Kennels. Others were furnished by O. B. Hark, Mrs. M. G. Faber, Mrs. Bonner, Mrs. Walls, F. E. Curtis and Mrs. F. J. Frank. We take this opportunity to thank them for their interest and help in this study.

CHAMPION FRANZA

A good specimen of the black and tan bicolor Cocker Spaniel, with typical markings, owned by the Daffodil Farm Kennels (Mrs. F. J. Frank). From a genetic point of view, this color combination is to be looked on as due to a pattern-factor which allows a lighter (lemon) color to show on certain well-defined areas of the body. The bicolor combination is certainly recessive, so when two black and tan animals are mated, they should always produce bicolor spotted dogs, never any solid-colored ones. (Fig. 1.)

	Zygotes	Gametes	Class 1 BLACK	Class 2 BLACK	Class 3 BLACK	Class 4 BLACK	Class 5 LIVER	Class 6 LIVER	Class 7 RED	Class 8 RED	Class 9 YELLOW OR LEMON
Zygotes			BE BE	BE Be	BE bE	BE be	bE bE	be bE	Be Be	Be be	be be
Gametes			BE | BE	BE | Be	BE | bE	Be | bE BE | be	bE | bE	be | bE	Be | Be	Be | be	be | be
Class 1 BLACK	BE BE	BE BE	B	B	B	B	B	B	B	B	B
Class 2 BLACK	BE Be	BE Be		3B 1R	B	3B 1R	B	3B 1R	1B 1R	1B 1R	1B 1R
Class 3 BLACK	BE bE	BE bE			3B 1L	3B 1L	1B 1L	1B 1L	B	3B 1L	1B 1L
Class 4 BLACK	BE be	BE | Be bE | be				9B 3R 3L 1Y	1B 1L	3B 1R 3L 1Y	1B 1R	3B 3R 1L 1Y	1B 1R 1L 1Y
Class 5 LIVER	bE bE	bE bE					L	L	B	1B 1L	L
Class 6 LIVER	be bE	be bE						3L 1Y	1B 1R	1B 1R 1L 1Y	1L 1Y
Class 7 RED	Be Be	Be Be							R	R	R
Class 8 RED	Be be	Be be								3R 1Y	1R 1Y
Class 9 YELLOW OR LEMON	be be	be be									Y

BREEDING COCKER SPANIELS BY ALGEBRA

Table I, for determination of average results to be obtained by interbreeding the different colors of Cocker Spaniels. To use table, first determine the class to which each dog belongs and then trace the columns to the square in which they meet. Here the colors to be expected and their average relative numbers will be found. A single large letter in the square indicates that the entire litter will be of that color. B = black, R = red, L = liver or chocolate, and Y = lemon. The class to which a given dog belongs can in some cases be determined by a careful analysis of the pedigree and its color, in others by the results of a previous mating. Or the procedure may be reversed. To determine the class of any animal examine a litter the result of mating with another animal, preferably of another color. The determination of the class of two black parents is the most difficult and several other matings may be necessary before an accurate determination is made.

produced herewith as Table I. A glance at the table will show that, using Little's formulae in which BE represents the essentials of the black color type, there will be four possible kinds of black dogs. These are BE BE, BE Be, BE bE, BE be, and will be mentioned as classes 1, 2, 3, and 4 respectively. So far as we have been able to learn there is no way to determine accurately, from the external appearance, to which class a given black dog may belong. However, rusty black dogs do not belong to class 1. Two classes of livers will be noted, bE bE, and bE be, classes 5 and 6. Two kinds of reds Be Be, and Be be, classes 7 and 8, are found; but only one kind of lemon, be be, class 9, can occur.

The red colors of Cockers seem to differ from the yellows of Pointers in being usually very clearly red, not yellow. For convenience we will hereafter speak of the different color types of dogs by giving their class numbers as they are shown in the table. Table I was next used by taking the individual pedigrees and determining from them the class to which each dog belongs; for example, Lucky is known to be of class 3, that is, he has the formula BE Be. He should be found to have the same formula judging by his offspring no matter to what color of bitch he was mated. In this particular case we have found in the records that Lucky belongs to class 3. We have records of nine of his matings, five times to females

	1	2	3	4	5	6	7	8	9
1		11B (2)	11B (1)				11B (2)	10B (2) 7B (1)	
2			8 B (1)	10B 5P (2)			7 B 6 R (4)	19B 13R (7)	
3			10B 36B 12L (10) 3L (2)				23 B (4)	10B 3 L (3)	
4				3 B 1 R (1)			3 B 2 R (1)	13B 3R (5) 7L 2Y	
5							8 B (1)		
6						3 L 1 Y (1)	9 B 5 R (2)	3 B 2 L (1) 2 R	
7							7 R (1)	39R (10)	
8								18 R 5Y (3)	3 R 1 Y (1)
9									

HOW EXPECTATION WAS FULFILLED

Table II shows the results of crossing various types of Cocker Spaniels, made up from the records of matings furnished to the authors, and based on Table I. Only those matings are here shown in which the formula (class) of each parent is known from two or more matings, B = black, R = red, L = liver, Y = lemon or yellow. Figures in parenthesis indicate the number litters.

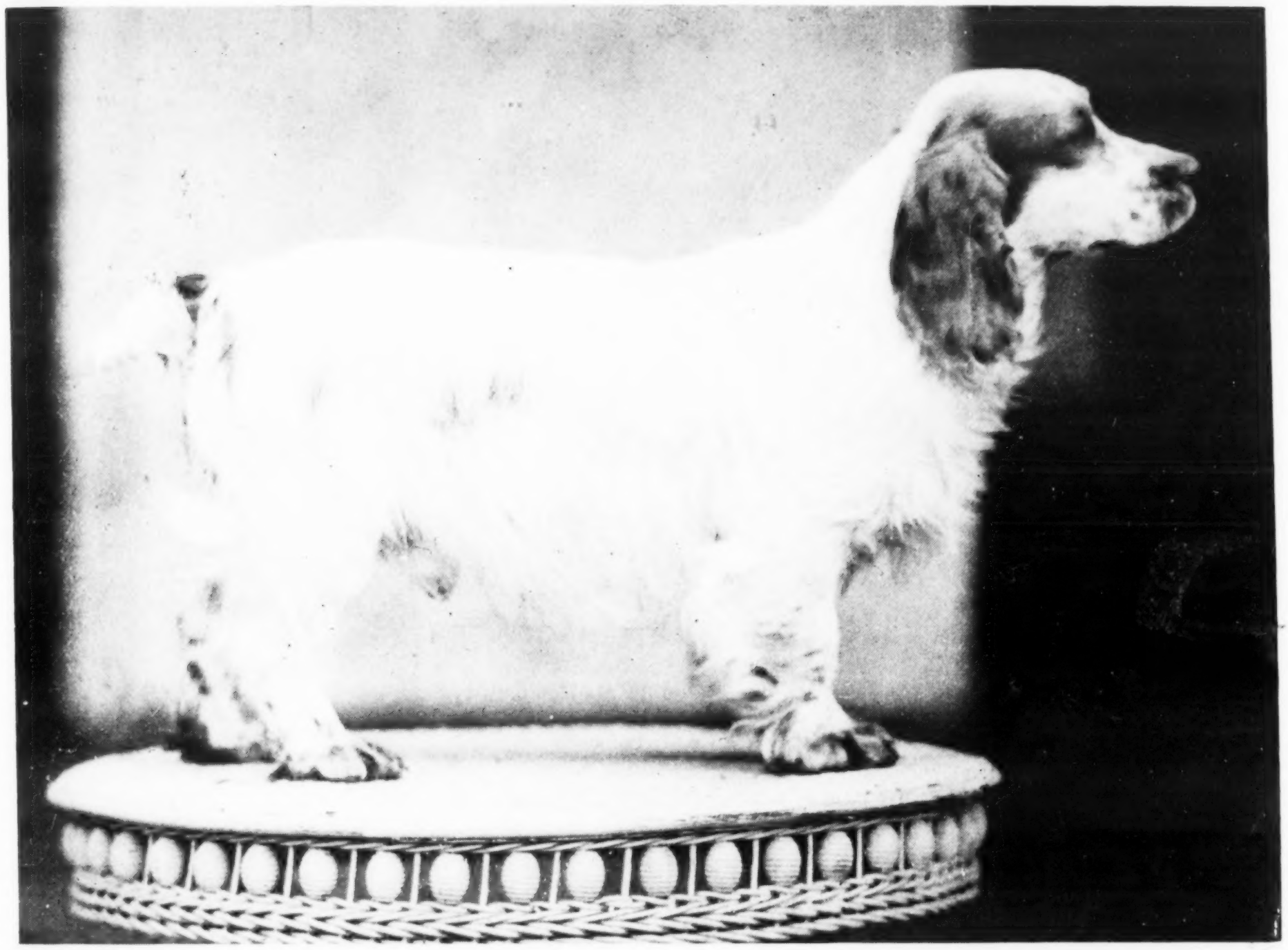
of class 3 or 4, three times to class 7, and once to class 8. The results of the first five matings gave thirty-six blacks and twelve livers, an exact agreement with the table. The next three matings, (classes 3 by 7) yielded fifteen black pups. The last mentioned cross (3 by 8) gave four blacks and one liver. In this list each of the red bitches of class 7 was mated more than once and in each mating behaved as a class 7 should, no discordant results being obtained.

We have now double-checked each individual which occurs in two or more matings, and find that the records show the actual existence of each of the nine classes represented, and that with two exceptions the results accord with those expected from Table I. Table II shows part of our actual records.

A comparison of this table with Table I will show that the results agree very closely with those expected. The litter shown as a result of the mating of class 4 by class 4 is placed here because the sire when mated to a red of class 8 gave four blacks and one liver. The only possible arrangement of these litters is to class one as 4 by 4 and the other as 4 by 8. This is, perhaps, the most questionable case given in the table. We have no records of the matings of liver to liver. But Rev. T. Moore-Smith, an extensive breeder of Irish Water Spaniels, writes us that they always breed true in his kennel, and so their formula is probably bE bE, and they represent the mating 5 by 5.

The litter shown as a result of two livers (6 by 6) is a litter of English Water Spaniels. However, there is probably very little objection to its inclusion since at one time both English and Irish Water Spaniels were freely bred with the Cocker Spaniels.

Out of eighty-nine litters there were two which could not be fitted into the table. A red dog of class 8 was sup-

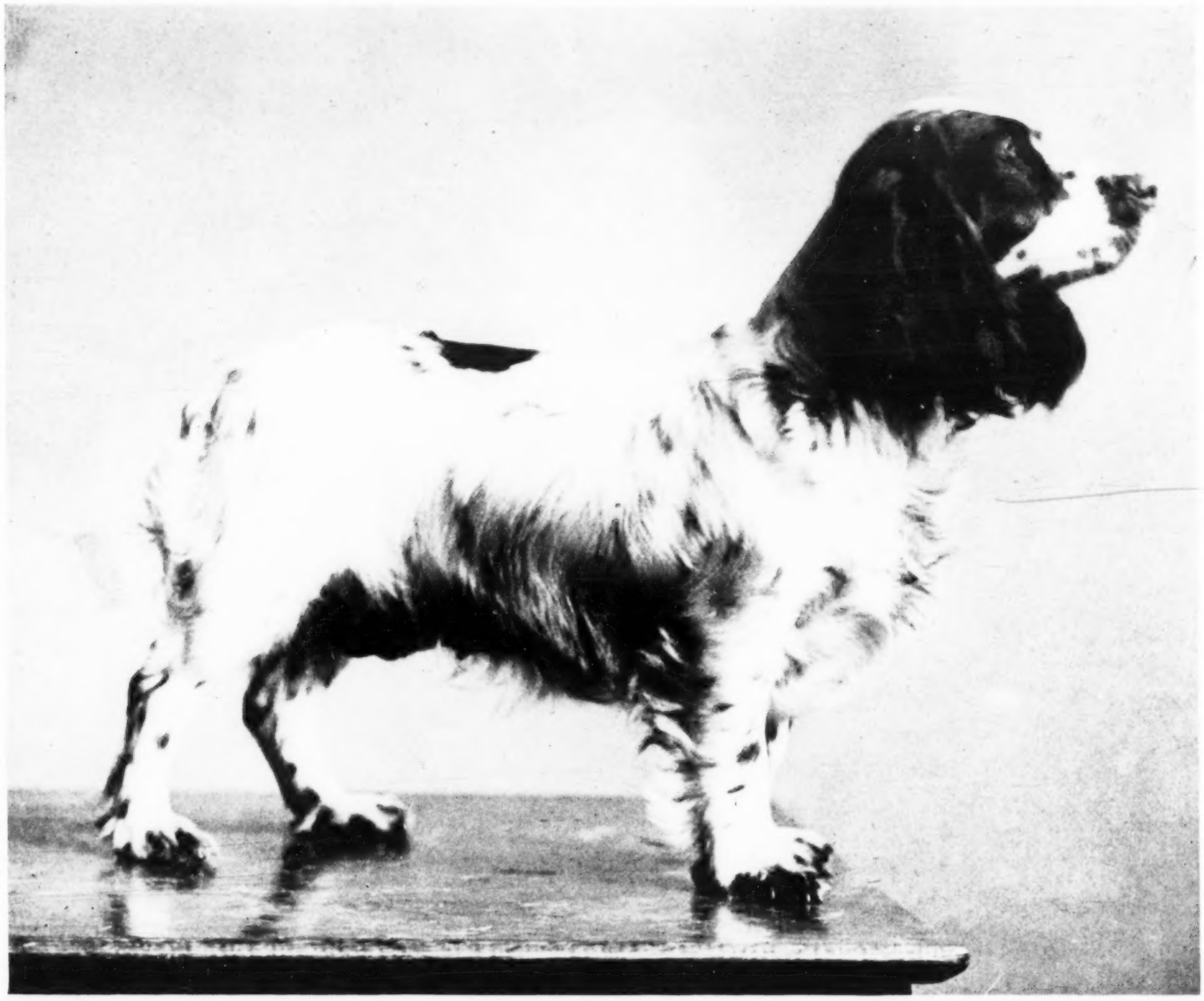


CHAMPION MEPAL'S THE JUDGE

By examination of pedigree and the results of previous matings, it is known that this red and white Cocker Spaniel has the formula Be Be, and also carries the recessive bicolor factor. On the basis of this information, it will henceforth be possible to predict with fair accuracy the kind of pups that will be produced from his mating with any female of known genetic makeup. If the latter is red, yellow or lemon, all the pups should be, without exception, red. Photograph from H. K. Bloodgood's Mepal Kennels. (Fig. 2.)

posedly mated to one of class 7. The litter resulting contained one red, one *liver*, and one lemon. It was recognized at once that for two reds to produce anything but red or lemon was decidedly out of the ordinary. Our data shows that in seventeen matings of red by red, eighty-three red or lemon pups resulted. This one exception, then, cannot well offset such clear evidence that red by red gives red or lemon especially when one considers the difficulty of keeping these active little dogs confined when the breeding period lasts from five to twelve days.

The second exception occurs in the cross of a black of class 2 with a black which we may call Bob. The first cross yielded six blacks. The second time that this mating was made its result was four blacks and one red. Taken by themselves these two litters are not necessarily incompatible. Two other matings with Bob show conclusively that he is class 1. Hence the second litter mentioned above was probably not sired by Bob. In this case whelping occurred several days ahead of time. This, taken with some other evidence shows conclusively that the mating was not correctly recorded. The conclusion to be drawn from a comparison of the two tables is, that in Cocker Spaniels the clear colors are inherited in typical Mendelian fashion and can be accurately predicted when the type of the parent is known and due regard is given to the vagaries of chance in fertilization.



CHAMPION SCIOTO TAD POLE

Black and white Cocker Spaniel bitch owned by the Scioto Kennels (Dr. J. McI. Phillips). Her formula has been ascertained to be BE Be, and reference to the table published on another page makes it easy to predict the results of mating her with any kind of dog of the same breed, whose formula is likewise known. Black is a harder color to work with than any other in Cocker Spaniels, because research shows that there are four kinds of black which look alike but breed differently. Furthermore, the presence of white (or "spotting") adds another complication, because it is apparently due to a number of separate factors, which usually act as a unit. As the spotting is usually dominant, we can say at a glance that the pups of this bitch will probably all be spotted, but whether they will be black and white or red and white can only be predicted by complete knowledge of the genetic makeup of the dog with which she will be mated. (Fig. 3.)

DILUTE COLORS

There occurs occasionally among Cockers a dilute color (dilute black), known as blue, and also individuals which appear to be white. Fig. 6 shows Simcoe Purity, one of these whites, owned by Frank E. Curtis. Simcoe Purity was from a solid black sire and a solid red dam. In the same litter were two red females, Doris and Betty. Mr. Curtis describes the productions of whites and blues from these in these words: "I bred Purity to his two litter sisters Doris and Betty and never failed to get one or two pure white pups in every litter, and with one exception they were always strong and healthy. I usually had in each litter what might be called a blue pup (in my opinion a miserable color) the others were either red or black. When Purity was in stud he was bred to outside bitches, but never threw a pure white pup." "Purity's eyes, nose, and foot pads were black."

CHAMPION SCIOTO PHILIP

Red and white Cocker Spaniel owned by Dr. J. McI. Phillips; his formula is known to be Be be, and he also carries the bicolor factor. Mated with a black female of pure ancestry, all the pups will be black; mated with a red female of pure ancestry, all the pups will be red; while if the mating is with a female that likewise carries the bicolor factor, all the pups will be bicolor. Results of the mating can be predicted with fair accuracy in the case of a mating with any other type of Cocker Spaniel. (Fig. 4.)

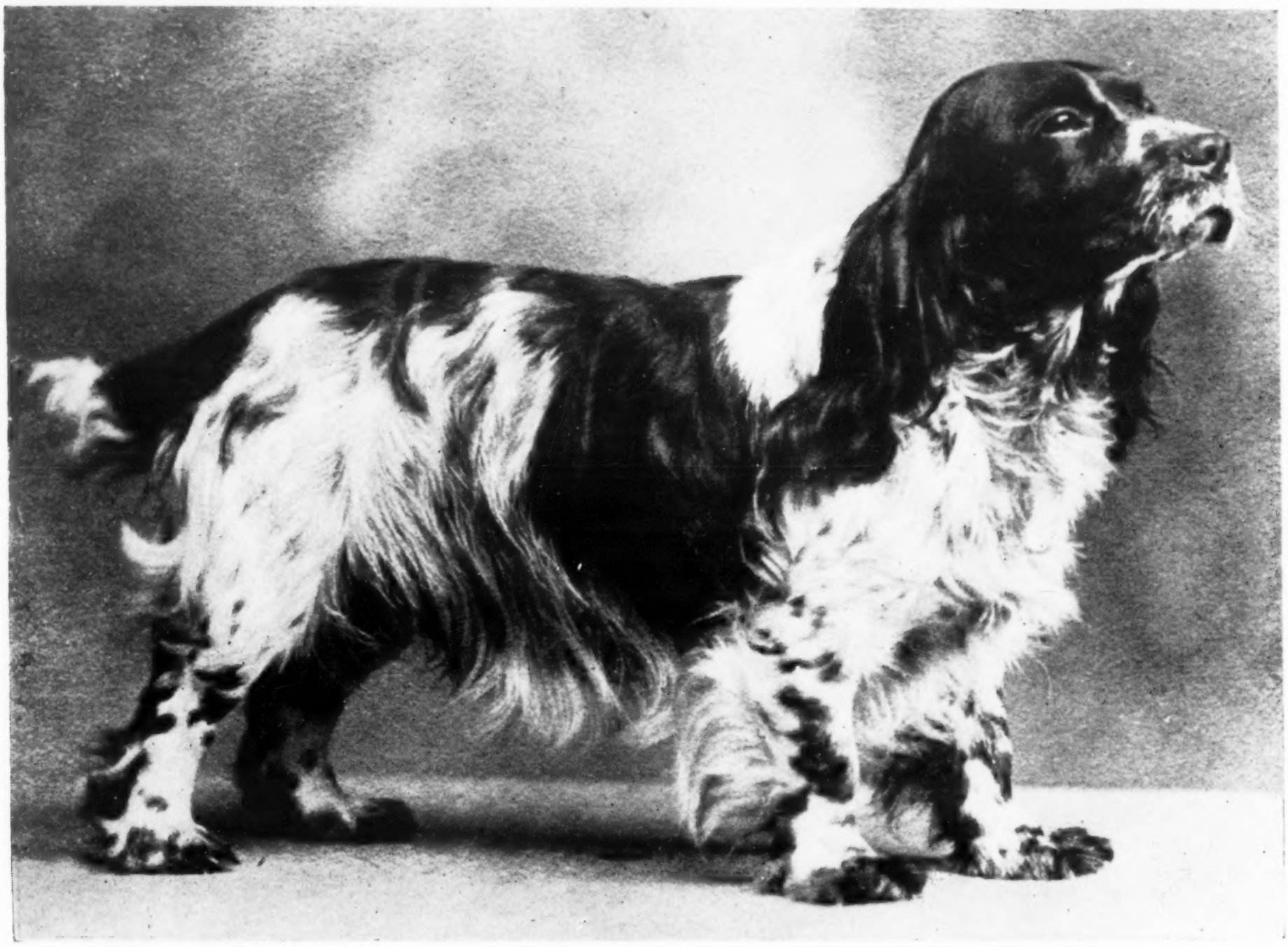
This single pedigree is mentioned to show that dilute colors do occur, and that the dilution factor is a recessive and becomes visible only occasionally or as a result of inbreeding in a strain which carries it. It seems improbable that the whites mentioned are true albinos. We are inclined to consider them as dilute lemon. Dilute reds are cream in color. The photograph of Simcoe Purity shows a slight darkening which might be due to yellow, invisible to the eye, but accentuated by the photographic plate.

ROAN PATTERN

A mixture of white hairs with the normally colored ones gives rise to the roan colors, of which our records show two litters. In the first a blue roan (black with white hairs) mated with a red spotted gave three black and white pups and two red roans, in the second another blue roan mated with red spotted gave three blue roans, and one liver roan. This is probably a 3 by 8 mating, the roan animal being homozygous for the roan factor. The roan pattern factor is evidently dominant.

SPOTTING

Spotting occurs in two general types, which we shall speak of as ordinary spotting and bicolor spotting. The ordinary spotting is the common condition in which the dog is more or less irregularly marked with patches of black and white, red and white, lemon and white, or liver and white. The spots vary from small breast or face



CHAMPION LUCKY

Black and white Cocker Spaniel owned by Pleasant Hill Kennels (O. B. Hark). Investigation of his pedigree showed that his formula was BE Be (class 3). According to theory, when he is mated with a female of similar genetic makeup, the pups should be 75% black and 25% liver. Five matings of this sort were recorded, and it was found that they resulted in thirty-six blacks and twelve livers—an exact agreement with the calculated total. By the law of chance, the results will not always come so close, when a small number is concerned; but it is evident that much of the uncertainty surrounding dog-breeding will be removed by the use of such Mendelian calculations as are described in the accompanying article. (Fig. 5.)

splashes to the condition in which the dog is largely white, with a few scattered marks of color. The method of inheritance is shown in the accompanying summary of our records.

Spotting is dominant in this case as in most cases so far studied, and is apparently due to multiple factors, which in their most perfect development act as a single factor. The irregularities

Table III

Mating	All Individuals Spotted	Individuals Mixed Spotted and Solid	All Individuals Solid
Spotted by spotted	207 (30 litters)	13 10 (5 litters)	4 (1 litter)
Spotted by solid	18 (3 litters)	49 45 (12 litters)	13 (2 litters)
Solid by solid	2 (very small spots on breast) (1 litter)	.....	19 (2 litters)

SIMCOE PURITY, A WHITE COCKER SPANIEL

A valuable "sport" in the breed is this dog, produced in the Simcoe kennels of F. E. Curtis, Simcoe, Ontario, Canada. He is the offspring of a solid black dog and a solid red bitch. The animal is not an albino, for his nose and foot-pads, as well as eyes, are dark in color. He is probably to be considered a dilute lemon. The value of inbreeding is well illustrated in a case like this: bred to outside females, Purity has produced no white pups, but when mated with his own close relatives a few pups in each litter are white. As a result, a pure white strain, hitherto unknown in the breed, might be established. (Fig. 6.)

in the table probably arise from the curious behavior of the spotting factor in different strains of dogs. If two individuals, which show small spots, coming from a solid color strain, are crossed, half of the resulting offspring are apt to be solid color, while the rest will be spotted. Selection for larger areas of white or color has a cumulative effect, which affects the ratio of spotted to solid offspring.

Another cause of apparent irregularities in the table arises from the fact that a dog showing a breast spot or white on the toes may be classed as a solid color in the kennel records. The two litters of thirteen solid color pups, shown in the last column of the table are from a tricolor mated with a spotted dog. The bicolor pattern factor, which will be described later, seems to have some effect in producing pups of solid color.

The second type of spotting, which we shall call bicolor spotting,[3] is in reality due to a pattern factor which allows a lighter (hypostatic) color to show on certain definite parts of the body. For example the condition most frequently seen is that of a black dog having dark or light red or lemon spots over each eye, and extended red areas distributed on the sides of the muzzle, inside of the ear, posterior surfaces of the legs, and on the ventral sides of the chest, abdomen, and tail. This pattern is most striking when found on dogs showing much black, but it is commonly

[3] See Pocock, R. I., 1907. On the Black-and-Tan Pattern of Domestic Dogs (*Canis familiaris*). Ann. Mag. Nat. Hist., Ser. 7. Vol. 19, pp. 192–194.

met in animals of other colors. Liver colored dogs may be marked with red or lemon, red dogs with lemon. If white occurs along with the bicolor pattern the dog is usually described as tricolor.

The inheritance of this factor is indicated by the following observation: Three matings in which principals are not bicolors or tricolors, but have tricolors among their ancestors, yield twenty-one non-tricolors and three tricolors, as shown in the pedigree below. Among these noted as non-tricolor are probably some red bicolors. When tricolors are crossed with non-tricolors which come from strains not showing the bicolor or tricolor patterns there result only plain colored offspring. However in two cases where tricolors were crossed with non-tricolors from strains containing the tricolor factors there occurred seven non-tricolor and three tricolor offspring.

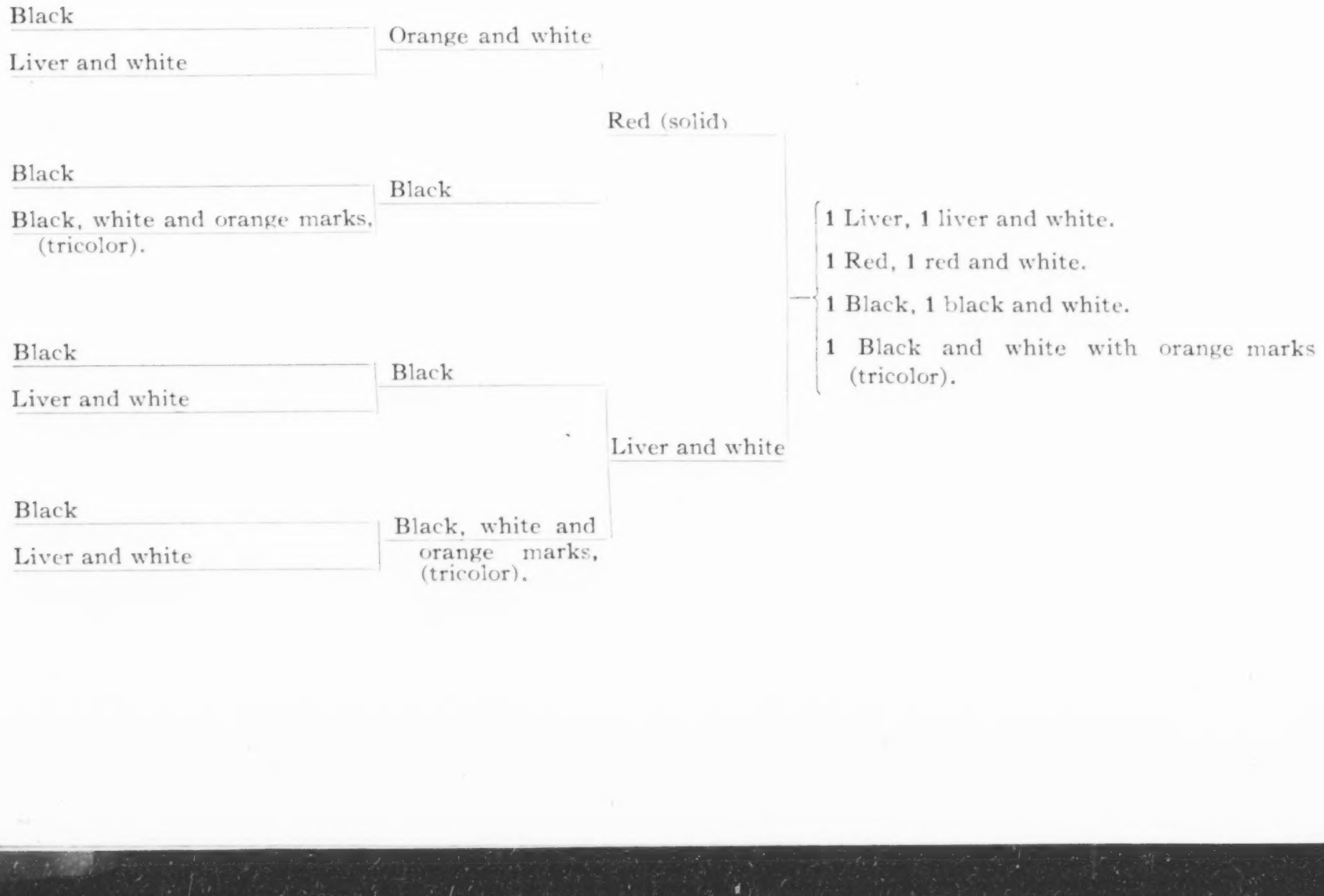
The bicolor factor is certainly recessive. Certain combinations should always produce tricolors. For example a tricolor of class 2 mated with a liver and white of class 5 which shows the buff marks should produce litters consisting exclusively of black tricolors. Several similar matings are possible, as can be seen from the table. We know of no such mating, but it should be an easy matter to test this hypothesis.

The tricolor markings with the hypostatic colors are limited, in the following breeds, to the same areas as in Cockers; Dachshunde, Toy Black and Tans, Manchester Terriers, Gordon Setters, King Charles and Prince Charles Spaniels, some Fox Terriers, Pointers, Beagles and Collies. The combination of red with lemon marks is more often found in Collies than in any other breed.

In certain Fox Terriers and Beagles the tan extends further up on the legs, and over the face, until the black is limited to the ears, the upper part of the occiput, and over the back and sides. In the Welsh Terriers this distribution of color is the usual one. In the Airedale the black is limited to a saddle commencing at the withers and extending over the back, tail and sides. All of these markings are probably due to the same pattern factor which we call bicolor in Cockers.

This pedigree was sent to us by one of our correspondents, as an example of the absolutely unpredictable nature of the heredity of colors in Cocker Spaniels! The solid red parent is evidently of class 8, while the liver and white parent is of class 6. The presence of a tricolor pup, and the fact that approximately half of the pups were spotted makes the pedigree most interesting. We shall leave it to the reader to decide whether or not the results of this mating could have been predicted with fair accuracy.

In this mating the number of lemons is insufficient. One of those noted as red may be, in reality, a lemon. In our records lemon seems to occur less often



than it is expected. This lack could be explained by the hypothesis that the gametes containing be are not as active in the fertilization process as those which contain B or E or both.

EYE, FOOT-PAD, AND NOSE COLORS

While we do not have complete records of the eye, foot-pad and nose colors, there are a few general observations which it seems well to add here for the sake of calling attention to the association of these colors.

The eye colors of Cockers range from black through various shades of brown to yellow. The eye color is not necessarily correlated with the coat color, or the color of the nose and foot-pads, except in the case of liver colored individuals where the eye is usually not darker than the coat, and is commonly much lighter. A black or red dog may have black, brown or yellow eyes. As far as our records go they show that the darker colors are epistatic to the lighter ones.

The nose color is always the same as the color of the foot pads. Black dogs always have black noses, while red dogs may have black or brown noses and foot pads, and may also have black spots on the skin which are not associated with colored spots in the coat. Lemon colored dogs may have the nose and foot pads black, brown, or a dusky pink. Chocolate colored dogs always have chocolate nose and foot pads. It is clear that the red animal can produce black pigment in the skin and eye but not in the hair, while the chocolate or liver colored individual can produce no black either in the eye or skin.

NEW PUBLICATIONS

THE NEXT GENERATION, by Frederick A. Rhodes, Chairman of the Morals Efficiency Committee of Pittsburgh. Pp. 290, price $1.50 net. Boston, Richard G. Badger, 1915.

Dr. Rhodes has attempted to test a great many social problems by the principles of biology, but his book bears the evidence of being hastily put together from newspaper articles, and is not likely to take rank as a serious contribution to eugenics. Although its scope and general attitude toward race betterment are admirable, the work is marred by a great many errors of fact, and a tendency to substitute quoted opinions of other people for reports of research. It is easy reading, however, and may lead students of the wide range of problems on which he touches to desire further knowledge of what biology has to offer them; in this case it will perform a real service.

Improving the Chile Pepper

The chile pepper (*Capsicum annuum*), so much relished by Mexicans, is the object of attention at the New Mexico Agricultural Experiment Station, where for the last five years it has been improved by selection for larger, smoother, fleshier pods and freedom from blight. Three good strains have been perpetuated from the fifteen with which the experiment started.

Studies in Correlation

Correlation is the principal concern of breeding studies, at the Montana Agricultural Experiment Station, the characters of plants being measured in comparison with those of their parents. Practical breeding of various cereals is also being done.

PLANT BREEDING IN CANADA

Work at Dominion Experimental Farms Begun by Late Dr. William Saunders—Mostly with Apples—Many Hardy Types Produced—Work with Vegetables and Ornamentals.

W. T. MACOUN
Dominion Horticulturist, Central Experimental Farm, Ottawa, Canada.

THE breeding of horticultural plants at the Dominion Experimental Farms was begun when the late Dr. Wm. Saunders brought from London, Ont., in 1888, a large collection of bush fruits and grapes which he had accumulated as a result of his work in cross-breeding begun in 1868. Since 1888 a continuous effort has been made to originate new varieties of fruits, vegetables and flowers which would be more useful in some parts of Canada than anything available from other sources. Canada had up to that time depended almost entirely for new varieties of fruits on foreign countries and while this is true to a large extent today, much has been done by the Dominion Experimental Farms to develop new plants. While the main purpose has been to obtain new varieties of commercial value, the possible discovery of underlying principles has been kept constantly in mind.

As the main work in breeding has been with the apple, the greater part of this article will be devoted to giving an account of what has been done with this fruit.

In 1887, seed of the wild Siberian crab apple *Pyrus baccata* was imported from the Royal Botanic Gardens, Petrograd, Russia, and sown at the Central Experimental Farm, Ottawa. Young trees grown from this seed were sent to the Experimental Farms at Brandon, Man., and Indian Head, Sask., in the prairie provinces, where the winters are very severe, the temperature at Indian Head falling at times to 50 below zero, Fahr. These trees proved quite hardy on a practically treeless prairie, while trees of cultivated varieties of crab apples and apples succumbed.

The fruit of this wild crab apple is very small, only half an inch in diameter, and it is quite astringent. In 1894 the late Dr. Wm. Saunders, then Director of the Experimental Farms, began crossing this wild crab apple with named varieties of apples in the hope of obtaining fruits of larger size and better quality than *P. baccata* but which would retain sufficient hardiness to endure the climate of the prairie provinces. All the crosses recorded have *P. baccata* as the mother; reciprocal crosses were not made. One hundred and sixty trees resulted from the first crossing and several hundred from subsequent work, or about 800 in all.

Some of the varieties of apples used as male parents are Tetofsky, Duchess, Wealthy, Anis, Beautiful Arcad, Broad Green, Excelsior, Fameuse, American Golden Russet, Haas, Herren, Krimskoe, McIntosh, McMahan, Osimoe, Pewaukee, Red Astrachan, Ribston, Scott Winter, Simbirsk No. 9, Swayzie, Tolman, Winter St. Lawrence and Yellow Transparent.

In 1899 thirty-six of the first crosses bore fruit and five of them were considered large enough and sufficiently good in quality to be propagated. By far the largest proportion produced fruit not sufficiently larger than the mother parent and of so inferior a quality as to be not worthy of propagation, but sixteen varieties were thought sufficiently promising to name. On weighing average specimens it was found that the best of these were from twelve to fourteen times heavier than the fruit of *P. baccata*. The largest fruits, however, were under 2 inches in diameter.

The better varieties of these crosses have little or no astringency and compare

very favorably in quality with the named crab apples on the market. Nearly all of them retained the marked crab characteristics of long, slender stem; thin, tender skin, and crisp, breaking flesh.

SOME HARDY VARIETIES

After being propagated and thoroughly tested on the prairies some of these have proved hardier than any other varieties of apples or crab apples tested, thus marking a stage of development in hardy apples for the prairie provinces. Some of the hardiest varieties have proved to be Jewel (*P. baccata* by Yellow Transparent, size 1.4 by 1.3 inches), Columbia (*P. baccata* by Broad Green, size 1.8 by 1.6 inches), Charles (*P. baccata* by Tetofsky, size 1.6 by 1.5 inches), Silvia (*P. baccata* by Yellow Transparent, size 1.4 by 1.5 inches), Tony (*P. baccata* by McMahan, size 1.6 by 1.4 inches), Elsa (*P. baccata* by Yellow Transparent, size 1.4 by 1.3 inches), Eve (*P. baccata* by Simbirsk No. 9, size 1.6 by 1.2 inches). Seedlings grown from these gave in nearly every case fruit smaller than the parent. As none of the fruits resulting from this cross was large enough to compare favorably with less hardy varieties of apples and crab apples, the best of these first crosses were, in 1904, recrossed with named varieties of apples with the object of obtaining varieties bearing larger fruits but which would retain sufficient hardiness to be grown in the open on the prairies.

In this work Dr. Saunders used the crosses as the mother parents in all cases. The varieties of apples used as male parents are McIntosh, Baldwin, Cranberry, Duchess, Northern Spy, October, Scott Winter, Simbirsk No. 9, Tetofsky, Yellow Transparent, Ontario, Gideon, Rideau, Haas, August, Walter, Wealthy, McMahan. From seeds obtained through this work 407 trees were grown at Ottawa which began to fruit in 1910 and of which a large proportion have borne. While many of these have borne fruit no larger than the mother parent, 24 have produced apples two inches and more in diameter. Some of the largest varieties which have fruited are Wapella (Dean by Ontario) size 2.25 by 2.25 inches; Angus (Dean by Ontario) size 2 by 2.5 inches. The parentage of Dean is *P. baccata* by Wealthy. Martin (Pioneer by Ontario) size 2.25 by 2.37 inches; Gretna (Pioneer by Northern Spy) 2 by 2.25 inches. The parentage of Pioneer is *P. baccata* by Tetofsky. Most of these second crosses retain the long, slender stem, the thin, tender skin, and the crisp, breaking flesh which are characteristic of *Pyrus baccata*, but a few are quite apple like.

It is not known yet whether these will be sufficiently hardy or not, but this will soon be determined.

It is to be regretted that the apple (*Pyrus malus*) was not used as the mother in these crosses, as it is believed by the writer that larger apples would have been obtained more quickly, but size might have been obtained at the expense of hardiness which is the first consideration on the prairies. If these second crosses prove hardier than any other apples or crab apples which have been tested they will mark another step in advance.

NEWER WORK WITH APPLES

As some of the Russian varieties of apples had proved hardy in certain places in the prairie provinces and had produced considerable quantities of fruit, a new line of breeding hardy apples for the prairies was begun by the writer in 1912. Seed was sown of such hardy varieties as Anis, Anisette, Antonovka, Beautiful Arcad, Blushed Calville, Charlamoff, Hibernal, Tetofsky and Yellow Transparent. After the trees had made one season's growth in the seed bed they were transplanted one foot apart into nursery rows 3 feet apart on the six Experimental Farms at Brandon, Man., Indian Head, Sask., Rosthern, Sask., Scott, Sask., Lacombe, Alta., and Lethbridge, Alta., and a few were sent to a sub-station at Fort Vermilion in the Peace River District. Some 50,000 trees were planted out in this way and it is planned to plant many more. Many of these trees have now passed through three winters and some of them have proved quite hardy, though a marked difference in this respect has

THE SIBERIAN CRAB APPLE

Actual size of the hardy Siberian crab apple (*Pyrus baccata*) which is being used by Canadian government breeders to cross with cultivated apples and produce a type that will be more resistant to the cold of the northern prairies. Some of the hybrids had fairly good flavor, without the astringency of the Siberian crab, but they lacked size, so they were recrossed with cultivated apples. The result is promising, in size and flavor, but it remains to be seen whether the hardiness of the Siberian stock has been retained. (Fig 7.)

been found. The hardy ones are now being transplanted to orchards for further test. It is hoped in this way also to obtain hardy varieties for Canada's coldest climates.

There is a very large area in Canada where the apple succeeds well, but where the range of suitable varieties is limited as up to recent years Canada has depended mainly on foreign conu-

tries for her fruits, and many of the varieties introduced from warm countries have only been suitable for the most favored districts in Canada, hence an effort has been made to obtain other and hardier sorts which will cover the season better. As the Horticultural Division was not organized to do much work in cross-breeding, the writer, in 1898, believing that in an orchard at the Central Experimental Farm containing between 400 and 500 named varieties of apples all sorts of combinations of characters would be taking place by natural pollination and that the chance of obtaining some good varieties would be very great, had seed saved of some of the best flavored apples then fruiting in the orchard as well as some other varieties desirable on account of other characteristics. There were included in these McIntosh, St. Lawrence, Fameuse, Wealthy, Shiawassee, Swayzie, Northern Spy, Winter St. Lawrence, Langford Beauty, Scott Winter, Salome, Lawver, Gano and American Golden Russet.

OPEN-POLLINATION SEEDLINGS

The seedlings from these were planted in the orchard in 1901 and later until about 2,000 were set out. The results from this work have been very gratifying. The first tree to fruit from seed was a Wealthy seedling now called Crusoe which fruited in 1903, two years after planting and five years from seed. Detailed descriptions have been made of the fruit of more than 1,200 of these seedlings. There have been so many good apples among them that 100 varieties have been named because giving promise of being useful in some part of Canada. The male parent was unknown in this series of seedlings, but it is very interesting to note that a large proportion of such seedling varieties from McIntosh, Wealthy, and Northern Spy had characteristics strongly resembling the mother parent, while Fameuse, Swayzie, St. Lawrence and others were lacking in this respect, although in the case of Swayzie the spicy flavor of the mother parent was marked in most of the seedlings. Only about 5% of the seedlings have been small or crab-like. Further details in regard to these seedlings will be found in the reports of the Experimental Farms.

Following are the names of some of the best varieties:

McIntosh Seedlings.—Melba, Joyce, Pedro. These are three apples of the McIntosh type: the Melba, an August apple, the Joyce, a September apple, and the Pedro, an October apple, thus extending the season of apples of this type.

Northern Spy Seedlings.—Autumn: Galton, Epsom, Thurso, Rocket, Tasty. Early winter: Lipton, Ascot. Winter: Elmer, Emilia, Sparta, Niobe.

While it is not claimed for any of these that they are better than Northern Spy or quite as good in most cases, they have all proved hardier than Northern Spy at Ottawa and they give a longer season of apples of the Northern Spy type.

The names might be given of seedlings of other varieties but as McIntosh and Northern Spy are two of the most popular varieties grown, their seedlings are given as examples. Detailed descriptions will be found in the annual reports of the Experimental Farms.

Previous to this series of seedlings, some 3,000 trees raised from seed received from north of Riga in Russia in 1890 had been tested but had given practically nothing of value as the fruit as a rule was of inferior quality.

CROSS-BREEDING APPLES

A little work in cross-breeding was done in the Horticultural Division in 1895 when McMahan was crossed with Scott Winter and Walbridge with Northern Spy, but beginning in 1899 some work has been done almost every year since. The parents used in making crosses are Anis, Anisim, Antonovka, Baldwin, Baxter, Bethel, Bingo, Cobalt, Crusoe, Duchess of Oldenburgh, Dyer, Danville, Fameuse, Forest, Glenton, Gravenstein, Hibernal, Lawver, Lowland Raspberry, Malinda, Milwaukee, McIntosh, McMahan, Newton, Northern Spy, North Western Greening, R. I. Greening, Rosalie, Rouleau, Scott, Winter, Stone, Winter Rose, and Walton. Reciprocal crosses have been made in many cases. There have been two

main objects in view in this work, first to obtain hardier winter apples for the colder parts of Canada where apples are grown commercially and, second, to obtain early bearing varieties covering the whole season, as there seems to be no good reason why more apples of the Northern Spy type should not be obtained which will bear as early as Wealthy and Wagener.

More than 1,000 trees are now growing as a result of a little crossing almost every year and nearly 100 of these have already fruited. So far not many apples have fruited which have been thought worthy of propagation, but there have been a few from a cross between McIntosh and Lawver where the object was to obtain varieties which would keep better than McIntosh.

In six out of ten crosses which have fruited with Lawver as the mother no marked resemblance to either parent is recorded, and similarly in three of the six with McIntosh as the mother. Of the four varieties with Lawver as the mother that have marked characteristics of the parent, two have distinct McIntosh flavor and two resemble McIntosh in color. The Lawver characteristics are not very marked. Of the six varieties with McIntosh as the mother only two show marked resemblance to either parent in the important characteristics of color, flesh, and flavor, although as regards season a large proportion resembles both parents. The McIntosh seedlings from open pollination have given a larger proportion with marked McIntosh characteristics than has been the case in this cross. While there are none of the sixteen varieties of this cross which have yet fruited which are as good as McIntosh in quality, ten of the sixteen are better than Lawver in quality and thirteen of the sixteen are later in season than McIntosh, and most of the varieties are of high colour and attractive in appearance. Following are those which have been named: Lawver by McIntosh-Holz, Vermac. McIntosh by Lawver-Mavis, Rustler.

The new varieties of apples which have been referred to are being tested in different parts of Canada and no doubt some of them some day will take their place among the list of best varieties offered for sale, but their introduction is not being pushed as there are too many already.

WORK WITH OTHER FRUITS

Pears.—Some work has been done in recent years with pears. It has been found that certain Russian varieties such as Bessemianka and Gliva Kurskaya are comparatively immune from fire blight and these have been crossed with other and better varieties.

Plums.—Little cross-breeding has been done but many seedlings have been grown of *Prunus americana* and *P. nigra*, some of which have been named. It is believed that *P. nigra* offers the better field of work as it has more good characteristics for Canadian conditions than *P. americana*.

Cherries.—Seedlings are being grown of a wild cherry from North-Eastern Asia called *Prunus tomentosa*, the fruit of which varies considerably. This is a bush cherry which is hardy where the tree cherries do not succeed. Varieties with better fruit are sought.

Grapes.—Little progress has been made in breeding grapes though many seedlings of Rogers Hybrid grapes are now being grown and it is expected that some good sorts will be obtained.

Gooseberries.—Seedlings are being grown of crosses between *Ribes oxyacanthoides*, *R. cynosbati*, and *R. grossularia* varieties looking to obtaining larger fruited sorts not subject to mildew.

Currants.—A number of seedlings and cross-bred varieties, the best saved from a large number, are being tested out.

Strawberries.—A large number of seedlings have been grown but few good varieties have been obtained. Some of the most promising are Cassandra, Cordelia, Desdemona, Ophelia and Portia. In recent years crosses have been made between wild strawberries obtained from different parts of Canada and cultivated varieties with the object of obtaining hardier sorts.

Early varieties of vegetables are of great importance everywhere, but are

much needed in certain parts of Canada. Selections for earliness have been made with tomatoes, beans, peas and corn particularly. The Alacrity tomato and Early Malcolm corn are two selections which have been most disseminated. During the past two years considerable work has been done in cross-breeding corn, the Squaw (flint), Early Adams (dent), and Early Malcolm (sweet) being mainly used as parents. The Squaw corn matures in districts where the nights are cool and the season without frost is short, whereas sweet varieties will not do so. It is hoped by crossing to obtain sweet varieties which will mature anywhere the Squaw does. Many interesting and promising crosses have been obtained.

Comparatively little work has been done in breeding ornamental plants, but some progress has been made with roses, sweet peas, geraniums, petunias and columbine. Two worthy varieties of roses originated at Ottawa by the late Dr. Wm. Saunders are Mary Arnott and Agnes, the former a brilliant crimson scarlet cross between *Rosa rugosa* and Prince Camille de Rohan, the latter, pale yellow with a salmon tinge, a cross between *Rosa rugosa* and Persian Yellow. Some interesting and attractive F_2 seedlings are growing from a cross made between *Berberis thunbergii* and *Berberis vulgaris purpurea*.

There is a specialist in the Horticultural Division who devotes his whole time to plant breeding.

Plant Breeding in Maryland

Plant breeding at the Maryland Agricultural Experiment Station is on a large scale, both as regards practical problems and the theoretical problems which it is attempting to solve. Mendelism is being investigated in cowpeas, in connection with selection; wheat, oats and barley are being cross-bred and selected, corn is being bred and studied in a series of experiments which has now been under way for ten years, mutations are being systematically sought in the cereals. A new variety of pear of good quality and resistant to blight is sought by crossing, particularly Kieffer by Seckel; apples are being bred in a similar way, to produce a good, early, red apple of good cooking quality. Grape hybrids include most of the hardy American species as well as the Malaga type of southern Europe, *Vitis vinifera*. Strawberries, celery, tomatoes, muskmelons, Irish potatoes, cabbage are also the subjects of projects destined to furnish more productive or disease resistant varieties and also to yield information about the laws of heredity. Finally, the station is doing genetic research with one kind of material which has been very little worked—namely, the castor bean (*Ricinus communis*), where the variation and heredity of individuals propagated from different branches and different flowers is being investigated. The production of ornamental plants, a work usually left to commercial nurserymen, has been undertaken to the extent of breeding improved strains of dahlia and Black Eyed Susan.

Plant Breeding in Michigan

A number of superior varieties of wheat—produced by the isolation of pure lines—have been put in the trade by the Michigan Experiment Station, as have two lines of oats. A study of the inheritance of earliness in oats has been running since 1911. Investigations of a more technical genetic nature are making in corn and wheat. A line of navy beans has been selected which is resisting blight to the extent of 8 or 10 bushels more to the acre than ordinary commercial strains. Alfalfa breeding has been carried through five generations, the object being to produce strains that will not only be hardy and productive in Michigan, with its severe climate, but will bear seed under such conditions. A considerable degree of success has already been attained.

WAR'S AFTERMATH

Survey of Parts of the South Yields Evidence of Biological Injury to Nation through Civil War, with No Evidence of Any Countervailing Effects

Review of a Book by

DAVID STARR JORDAN AND HARVEY ERNEST JORDAN

IT IS fairly obvious to any thinking person that war is a tremendous factor in cacogenics, because it destroys men who are superior—physically, at least— and leaves the relatively inferior to perpetuate the race. Biologists have been calling attention to this fact for many years, but until recently no effort has been made to particularize the indictment of militarism. An attempt has recently been made in this direction, by David Starr Jordan and Harvey Ernest Jordan, working under auspices of the World Peace Foundation. Their results have been published in a little book[1] called "War's Aftermath." This is the first attempt in history to put the postulate that war *reverses* the action of natural selection to the test of actual investigation.

At the very start of the research, there were certain facts available whose meaning could be hardly misinterpreted. It was known that nearly a million young men, largely of superior fitness, had perished in the Civil War, and it was inconceivable that their loss should not have affected the racial stock of the nation. The loss was not unequally divided between North and South; but it represented 2% of the white population of the North, and 10% of the white population of the South. "The Southern loss of human wealth was therefore five times as heavy as in the North, and the results of this loss should be correspondingly more evident. This is in fact the case, although in certain Northern States, as Vermont, Connecticut, Massachusetts, the loss was almost as great relatively to the population as in Virginia or Georgia.

"This loss fell on the men of that part of the community racially most valuable, the young men between the ages of 18 and 35. At least 40% of these in the South died without issue. Even among the Southern States this loss was unequally distributed, Virginia and North Carolina apparently suffering most. Both Virginia and North Carolina were settled mainly by the same British stock, many Scotch being represented and in certain localities the Pennsylvania Germans. The racial quality throughout was high, and it may be assumed to have been about equally high and as good as the best in the United States or in the world, at the time of the outbreak of the war."

EXACT MEASUREMENTS WANTED

Such broad facts were known, but it seemed desirable to make a more intensive study of some small portion of the area most affected, in order to determine the exact nature of the war's aftermath. The investigators knew that *some* racial hurt has been caused; they wanted to find out *how much*. After a careful survey of the field, Rockbridge and Spottsylvania counties, in Virginia, and Cobb county, in Georgia, were chosen as likely to yield the most satisfactory results.

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[1] War's Aftermath: a preliminary study of the Eugenics of War, as illustrated by the Civil War of the United States and the late wars in the Balkans; by David Starr Jordan, Chancellor of Stanford University, and Harvey Ernest Jordan, professor of histology and embryology in the University of Virginia. Pp. xxxi+104, price 75 cents net. Boston and New York, Houghton Mifflin Company, 1914.

If the investigators ever imagined that they could get even a rough measurement of the biological effects of the war, they were soon undeceived. The problem was found to be very complicated, even in the favorable localities chosen, and they had to content themselves with getting "approximate results by less direct methods." The data on which their conclusions are based are opinions, almost as much as facts, and were thus secured:

"We took advantage of every opportunity to interview representative men, and especially veterans of the war, on the question at issue. From hundreds of these, valuable information was gleaned. These conversations were crystallized into a set of thirty propositions which were one after another to be tested. These propositions, usually in the words of some thinking veteran, were put into the form of a questionnaire and sent broadcast over the South to the surviving Confederate officers and other men of intelligence, for comment and criticism."

It will be possible in this review only to touch on the propositions of the greatest importance, from a eugenic point of view. It was found that the leading young men of the South, from a social point of view, were mostly members of select companies of militia, at the outbreak of the war; and these were the first to enlist. The loss of life among them was naturally greater than among those who entered the war near its conclusion. "The flower of the people went into the war at the beginning, and of these a large part died before the end." Those who did not fight until conscripted, late in the struggle, were on the average inferior to the volunteers, both in physical and moral qualities. But as the mortality was lower among them than among the superior volunteers, who entered the war earlier, the deterioration in the average quality of the race was increased to the same extent. The deserters, and those who took to the hills to avoid conscription, also survived to multiply. "The result of this was that the men of the highest character and quality bore the brunt of the war and lost more heavily than men of inferior quality. This produced a change in the balance of society by reducing the percentage of the better types without a corresponding reduction of the less desirable types; a condition which was projected into the next generation because the inferiors lived to have progeny and the others did not."

HALF OF BEST BLOOD LOST

It is admitted that the above conclusion may be a little too general and sweeping, but there is reason to believe that a half, perhaps considerably more, of the "best blood" of the South was lost in the war. As to just how good this blood was that was lost, there is no accurate means of judging.

In addition to the loss of men, the birth-rate was likewise affected through changes in the condition of the women. "Widows of soldiers suffered great hardships and most of them never remarried; the death-rate among them was unusually high for the first ten or fifteen years after the war. The sweethearts of many a victim of the war never married; with the elevation of the middle class and the lack of men of their own class many girls of the aristocracy married men beneath them in station." The result stated in the last clause, the authors admit, "is far from a racially unmitigated evil, regarded in a broad and democratic sense," but on the whole the effect of the facts outlined in this paragraph was still further to decrease the production of superior children, in the years following 1865.

When they tried to decide how far, if at all, the present population of the South is inferior to that of antebellum days, the investigators naturally found their way paved with difficulties. There is some reason to believe, it appears, that the farming class is as good as ever. Perhaps "the class of men attending courts does not measure up in intelligence or ideals with those before the war." It is thought that "the public men of the South do not measure up to those of old times," but this condition to a certain extent prevails through the nation. It is admitted that

"after the war the best of the middle class—farm managers and commercial men—rose to equality with the remnants of the old aristocracy," but the statement that "the Civil War destroyed the cream and stirred up the dregs" met with much disapproval, and leads the investigators to say, "There is probably more than a grain of truth in the assertion that the 'poor whites' of the South have never had justice done them. They are much better raw material than is generally supposed."

On the whole, however, and making due allowances for many qualifying and compensating factors, "The men who got themselves killed were the better men."

The authors made an attempt to find whether environmental factors could be charged with part of the blame for the South's present condition. If the lack of great men, or the lowering of ideals, were due to faulty education, or the influx of "carpet-baggers" from the North after the war, or emigration, whisky, or cousin-marriages, then war could to that extent be acquitted of reversing selection and deteriorating the race. It was admitted that some or all of these factors might play a part, but emigration was the only one which seemed to deserve much consideration, and that appears to have affected only limited regions.

Again, it was suggested that although the strong fell first in battle, the weak fell first in camp; so that the balance remained about the same. Even if considerable weight be granted this circumstance, the loss of strong men, who could ill be spared, remains.

SOME BENEFITS SEEN

Some social and economic benefits from the war are suggested. "The South is the better by far for the spread of education, for the willingness to work, for the loss of slavery, for the maintenance of the Union, and for the development of business. But for the war, as war, there was no redeeming feature, no benefit to any one, not one word to be said,"[2] was the last of the propositions submitted to the survivors; and it seems to have won the assent of a large number of them.

"In conclusion," the authors say, "we are impressed that with respect to the eugenic aspect of the Civil War we are dealing with matters insusceptible of precise determination. Many factors united to work an apparently racial effect; these factors are so intricately and reciprocally interrelated as to preclude definite isolation and tracing of the complete effects of any one. The patent results are thus more or less matters of environment as well as of differences in germ-plasm, of euthenics as well as eugenics. . . . A just weighing of all this evidence, however, leaves a decided balance in favor of grave racial hurt in consequence of war, and this certainty is cumulative, becoming more definite with the consideration of each new area. Each of the other baneful influences associated with the problem, social, cultural and economic devastation, emigration, pensions, etc., is nevertheless the direct consequence of war and should be debited to it. Moreover, even granting that the South and the country as a whole are, relative to antebellum days, no poorer racially in consequence of the war—an assumption no one can maintain in the face of the enormous waste of one million splendid souls—it is further certain that, could we have had the inspiring presence and wise counsel of these martyrs and their potential offspring, the country would now be immeasurably better off in a yet higher average of physical, mental and moral stamina. In brief, the theoretical argument for reversed selection seems beyond question. The actual facts concerning our Civil War and the events which followed yield no direct countervailing evidence. We must, therefore, decide that the war has seriously impoverished this country of its best human values."

[2] The words of a Confederate officer.

PHOTOGRAPHS OF LARGE TREES

Sycamore in Indiana is Biggest Recorded in Prize Contest of Association—California Oak Tops List Among Nut-Bearers—Many New Records Established and Much Valuable Data Put on File by Competitors

BARRING conifers, the largest tree which the American Genetic Association has been able to discover in the United States is a sycamore at Worthington, Ind., 42 feet, 3 inches in circumference.[1] This is the result of offers of two prizes of $100 each for photographs of large trees, made in the JOURNAL OF HEREDITY for October, 1914, by Mr. Charles Deering, of Chicago, and Mr. W. A. Wadsworth, of Geneseo, N. Y.

The offer terminated on July 1, 1915, and brought to the office of the association photographs of 337 trees in all parts of the United States. Most of them were accompanied by data as to surroundings and history, which make a distinct contribution to our knowledge of native trees. To go over all this data and get out all that it has of interest to science will be the work of some months; in this issue of the JOURNAL little more can be done than to announce the most evident results.

Photographs of the Indiana sycamore were sent in by Herman L. Hayden, Worthington; Herbert H. Sloane, Worthington; and Dr. William B. Clarke, Indianapolis. After considering both the excellence of the photographs and the fulness of the information submitted, it was decided to award the prize of $100, offered for the photograph of the largest non-nut-bearing tree to Dr. Clarke.

The second prize was offered for the largest nut-bearing tree, and went without doubt to Charles Libhart, of Stockton, Cal., who submitted the photograph shown in Fig. 8 of a valley oak 37 feet 6 inches in circumference,, standing on the ranch of B. F. Gruver in Priest Valley, San Benito County, Cal.

It is impossible even to mention all the valuable records sent to the association. Many persons, entering into the spirit of the contest, sent photographs with the remark that they knew the trees they submitted were not prize winners, but wanted them put on record for the benefit of science. Others sent particularly large specimens of species that ordinarily reach only a small size, realizing that the prize would go to some larger species, but desiring to aid the association in getting a record of the maximum attained by all species. Thus excellent specimens of such trees as the persimmon, holly, sassafras, chinquapin, catalpa and white birch were submitted, and make highly valued additions to the available information on large trees in the United States.

To return to the Indiana sycamore (Fig. 7*a* and frontispiece) detailed measurements of circumference follow:

1 ft. above the ground	45 ft. 3 in.
5 ft. above the ground	42 ft. 3 in.
East branch	27 ft. 8 in.
West branch	23 ft. 2 in.

The height is said to have been reduced considerably in recent years by wind and lightning; it is now estimated at 150 feet, while the spread is about 100 feet. As far as is known, these are the largest authentic measurements of a sycamore now living.

The American sycamore (*Platanus occidentalis*) is more correctly called the plane tree; it is not related to the Biblical sycamore (*Ficus sycamorus*, a species of fig), mentioned particularly in connection with Zaccheus who, as the old Primer put it, "did climb a tree, his Lord to see." The American sycamore is also known in some parts of the

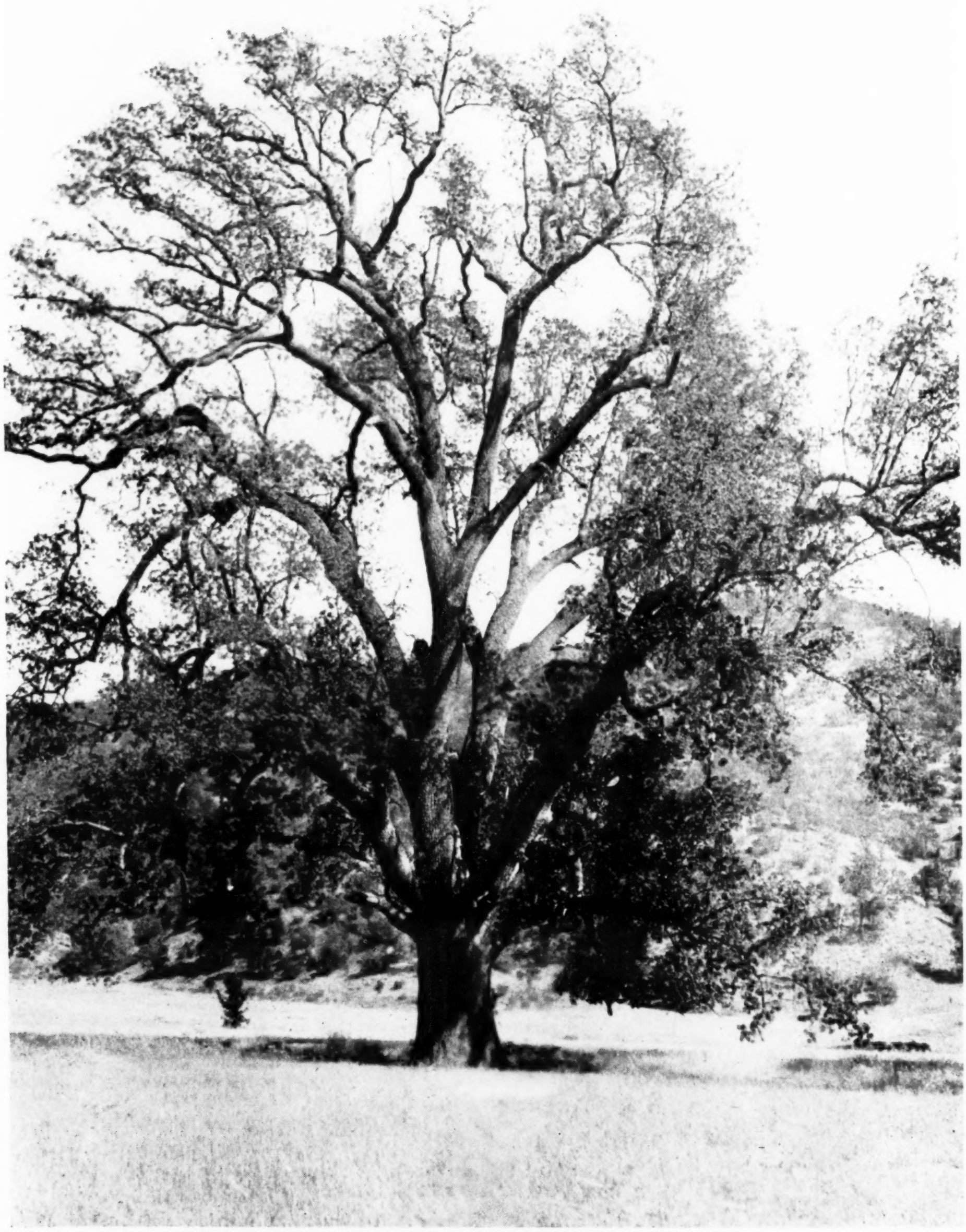
[1] Unless otherwise specified, all circumferences given in this article refer to a measurement made 5 feet from the ground. This was the stipulation in the contest, and is in accordance with the general practice of foresters and botanists.

THIS IS PROBABLY THE LARGEST SHADE

Residents of the "corn belt" have long boasted of the fertility of their river bottoms; the existen
The sycamore here shown stands near the bank of the White River, in a field belonging to Solo
is at the right. The tree is subject to frequent inundation, when the White River overflows its
the tree. It is entirely possible that this periodical inundation, like that of the Nile, is partly r
has attained unusual size; old settlers tell of a sycamore, long since gone, which measured 67 fee
foresters declare that not to be the case; its unusual form is due to the fact that at an early age

NOW STANDING IN THE UNITED STATES

specimen as this proves that the rich, black loam can produce to perfection bigger plants than maize. ...xson, of Worthington, who stands at the left; the competitor, Dr. William B. Clarke, of Indianapolis, ...nd deposits a new layer of silt on the fields; once, at least, the water has reached as high as the fork of ... for the fertility of the region and the growth of the trees, more than one of which in that region ...nference. It has often been suggested that this specimen is in reality two trees grown together, but ...ded and grew up in two directions instead of one. (Fig. 7*a*.)



THE LARGEST NUT-BEARING TREE

California's valley oak (*Quercus lobata*) which grows in the hot interior valley and on the foothills of the Sierra Nevada Mountains is probably the largest nut-bearing tree in the United States, and this is by far the largest specimen which has come to the notice of the American Genetic Association. It stands on the ranch of B. F. Gruver in San Benito County, Cal., and was photographed on a vacation trip in August, 1910, by Charles Libhart of Stockton. Unfortunately, the photograph fails to convey a just idea of the size of this tree, which is surrounded by smaller oaks of the same species. It is 125 feet high and 37 feet 6 inches in circumference. According to Mr. Gruver, it bears a ton of acorns in a good season. (Fig. 8.)

country as the buttonwood or buttonball, in allusion to its large seed-balls, which hang on the tree all winter.

The tree here illustrated is located in the rich alluvial loam of the White River bottom. As this stream frequently overflows its banks, it periodically deposits a layer of silt around the tree; but the floods appear to have done no damage to it, although on one occasion it is said the water reached as high as the fork, 15 feet from the ground. It may be believed that this frequent deposit of alluvium is one of the factors which has caused the great growth of the tree. Many other large sycamores, beech and walnut trees have been produced in the same locality, but most of them have been long since felled for lumber. One of the sycamores which met this fate was so large that it could not be hauled to the mill, but was floated down the river; another, cut in the last few years within 500 yards of "the big tree," as the prize winner has been known in the region since the first settlers arrived, made five 10-foot logs, the largest of them 60 inches in diameter and measuring 1,960 board feet. The tap log was about 43 inches in diameter. These figures give some idea of the amount of lumber that a single one of these giants will yield.

As is most large sycamores, the base of this tree is hollow, the opening being on the opposite side from that shown in the photograph. Fire has recently damaged it.

That Indiana can produce even larger trees than this may be inferred from the following letter which appeared in the Indianapolis *News* of July 5, 1915, after a reference to the Worthington specimen:

LARGER ONE NOW GONE

"I can tell of a much larger one, but, unfortunately, the tree is gone, and nearly all who have seen it. I have twice written of it. The first time to the *Cincinnati Weekly Enquirer*, about the year 1867, the second time for the *Museum*, a monthly scientific journal, published at Albion, N. Y., by Professor Webb. I then made the claim that it was the largest tree ever grown in the United States this side of the Yosemite Valley. The article in question can be found in the December number, 1896, and embodies the following facts:

"The tree grew within a distance of 100 feet of the bank of Driftwood, on the east fork of White River, about 3 miles southeast of Brownstown, Jackson County, Indiana. My father bought the land on which it stood as school land, sixteenth section. I have often heard him tell about the tree. I never saw the tree standing, but the stump was still to be seen up to as late as 1864. I have on several occasions seen a pole 18 feet long turned completely around within the stump, which was hollow. It was measured by the surveyors of original survey, and was over 67 feet in circumference. The trunk of the tree was about 15 or 20 feet high when it made three branches. The smallest one of the three was more than 7½ feet in diameter, or, as father said, as high as a man's head when on horseback.

"This tree in part resembles the Worthington sycamore, in having branches near the ground. Of course, this tree was *P. occidentalis*.

"M. CRABB."

If Mr. Crabb's tree was measured at the ground line, 67 feet is not an impossible measurement, although it is doubtful if there is a tree of the species now living which reaches any such size. F. André Michaux, one of the earlier authorities on North American trees, and a naturalist whose accuracy is well attested, wrote[2] on the subject as follows:

"On a little island in the Ohio, 15 miles above the mouth of the Muskingum, my father measured a buttonwood which, at 5 feet from the ground,

[2] "The elder Michaux," under auspices of the French Government, explored North America from 1785 to 1796, studying the trees. His son, F. André Michaux, accompanied him in his later travels. The father published part of his work, but met with an untimely death in Madagascar; the son returned to America in 1801 and 1807 to complete the material for the "North American Sylva," which was published in Paris 1810-13. The quotation above and others in this article are from the translation published in Philadelphia, 1865, by J. J. Smith, with a supplement by Nuttall; Vol. II, pp. 50, 51.

CHESTNUT TREE FROM NORTH CAROLINA

After the California oak, the largest nut-bearing tree discovered by the association is this chestnut (*Castanea dentata*) 3 miles from Crestmont, N. C. It stands on the main range of the Big Smoky Mountains, dividing Tennessee and North Carolina; the altitude of the location where the tree grows is about 2,900 feet. This specimen is about 75 feet high; its girth at 7 feet from the ground is 33 feet 4 inches. Photograph from E. O. Abernethy, Crestmont, N. C. (Fig. 9.)

was 40 feet and 4 inches in circumference, and consequently more than 13 feet in diameter. Twenty years before, General Washington had measured the same tree, and found it to be of nearly the same size.

"In 1802 in a journey through the western States, I found on the right bank of the Ohio, 36 miles from Marietta, a buttonwood whose base was swollen in an extraordinary manner. My traveling companion and myself measured it, and at 4 feet from the ground we found it to be 47 feet in circumference. This tree, which still exhibited the appearance of vigorous vegetation, ramified at 20 feet from the ground. A buttonwood of equal size is mentioned as existing in Genesee. The astonishing dimensions of these trees recall the famous Plane Tree of Lycia, spoken of by Pliny, whose trunk, hollowed by time, afforded a retreat for the night to the Roman Consul Licinius Mutianius with eighteen persons of his retinue. The interior of this grotto was 75 feet in circumference, and the summit of the tree resembled a small forest."

THE BIGGEST ON RECORD

But the biggest record is that left by Robert Ridgway, who found the prostrate and largely decayed trunk of a sycamore near Mount Carmel, in Illinois, the crumbling base of which measured 66 feet in circumference.[3] At 20 feet from this, where the trunk divided into three large limbs, its circumference was apparently 62 feet. There is certainly no other broad-leaved tree on record in North America which equals these dimensions.

Mention was made, in the quotation from Michaux, of the oriental plane tree (*Platanus orientalis*), which has been introduced to America and is found in many parts of the United States. It may be interesting to digress long enough to see the size this historic tree reaches. Elwes and Henry,[4] who have made a particular study of the records of individual trees, write:

"One of the most remarkable was a tree growing in the village of Vostiza, on the Gulf of Lepanto, in Greece, which measured, in 1842, 37 feet 4 inches in girth at 5 feet from the ground, and was estimated to be 130 to 140 feet in height. This tree is supposed to be the one referred to by Pausanias, who wrote in the second century A. D., yet in 1842 the trunk appeared to be perfectly sound, though many of the larger branches have succumbed to age and storm.

"The famous plane of Bujukdere on the Bosporus is not a single trunk, but is formed of nine stems fused together. According to Ch. Martins, in September, 1856, the height was 200 feet—evidently an exaggeration—with a spread of branches 373 feet in circumference. One trunk girthed 18 feet; two trunks united together for some distance girthed 36 feet, the remaining six trunks being in an ellipse of 76 feet. One of the stems was hollow and afforded stable room for two horses.

"The tree of the Janissaries, the ancient plane which stands in the Court of the Janissaries in the Old Seraglio at Constantinople, was 39 feet in girth at 3 feet from the ground in 1890.

"In the *British Medical Journal* of June 21, 1902, there is an excellent account, with illustrations, of a plane tree in the island of Cos, which from its appearance must be one of the oldest trees in the Mediterranean, if not so old as its somewhat mythical history alleges. Local tradition says that under this tree Hippocrates, the celebrated Greek physician, taught the art of healing no less than 2,300 years ago. . . . Mr. Von Holbach, who measured it, gives the girth of its hollow trunk as 18 meters.

"Bonvalet, on his way from Samarcand to Amu, states that he halted at Sarifui, near the residence of the chief, under a plane tree, which was about 37 feet in diameter at 6 feet above the

[3] Proc. U. S. Nat. Museum, 1882, p. 288.

[4] H. J. Elwes and A. Henry, "The Trees of Great Britain and Ireland," Vol. III, p. 623; Edinburgh, 1908.

CONNECTICUT'S FAMOUS ELM AT WETHERSFIELD

"The Great Elm" has always been claimed by people in Connecticut to be the largest in the United States, and it seems quite likely that this claim is well founded. The American Genetic Association has not been able to get authentic record of any larger living specimen. The smallest diameter of the trunk (4 feet from ground) is 28 feet, while the basal girth, swelled by buttresses, is 55 feet 6 inches. Its height is approximately 100 feet. Estimated to be 250 years old, the tree seems to be in full vigor at the present time, and as the residents of the town have enough civic pride to care for it, the tree should live for several generations more. Photograph contributed by F. W. Tuttle, Hartford, Conn. (Fig. 10.)

ground. In his book, a picture of the tree is given, and a great limb comes off low down, which evidently was included in the above measurement. The tree appears to be about 50 feet in girth at the base below where the limb comes off. Another enormous tree, 49 feet in girth, stands in the grounds of the mosque of Tajrish, a village in the Elburz mountains, north of Teheran in Persia."

Although a number of other fine sycamores were sent to this association, none of them could compete with the Indiana specimen, and it seems extremely probable that this is the largest tree in the eastern United States at the present time. When one gets to the Pacific Coast, he enters the region of the Sequoias, whose giant bulk puts them in a class by themselves. Indeed, specimens of the Big Tree (*Sequoia*

gigantea) can be found which are almost as large in diameter as the Worthington sycamore is in circumference.

As was expected, all the nut-bearing trees proved to be considerably smaller than this sycamore. The California oak was easily first, but a close second was the big chestnut near Crestmont, N. C., sent in by E. O. Abernethy. At 7 feet from the ground this specimen measured 33 feet 4 inches in circumference, and owing to the peculiar formation of the trunk, it would have yielded much larger figures, if measured at a lower point. It is fair to assume that the chestnut represents the largest nut-bearing tree in the eastern United States, and is only surpassed by the huge oaks of the Pacific coast.

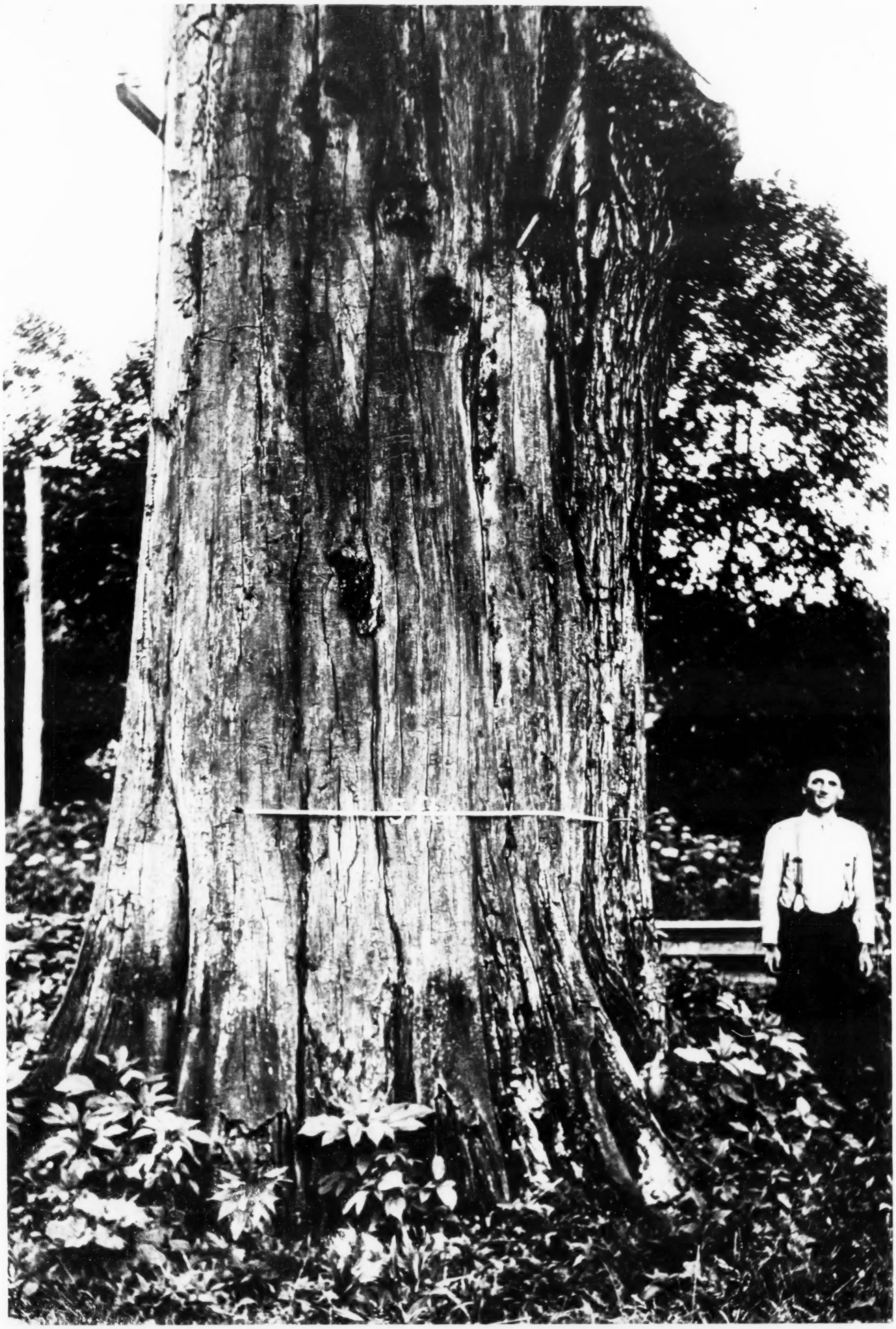
On this subject, Michaux wrote (III, p. 12): The chestnut "prefers the sides of the mountains or their immediate vicinity, where the soil in general is gravelly, though deep enough to sustain its perfect development. The Chestnut of the Old World attains its greatest expansion in similar situations: an example is said to exist on Mount Etna of a Chestnut 160 feet in circumference, or about 53 feet in diameter, and large enough to shelter 100 men on horseback beneath its branches; but its trunk is hollowed by time almost to its bark; near it stand several others more than 75 feet in circumference. At Sancerre, in the Department of the Cher, 120 miles from Paris, there is a chestnut which at 6 feet from the ground, is 30 feet in circumference; 600 years ago it was called the *Great Chestnut* and, although it is supposed to be more than 1,000 years old, its trunk is still perfectly sound and its branches annually laden with fruit. I have never met with instances of such extraordinary growth in the United States; but the American species is probably susceptible of an equal development, since in the forests of North Carolina, it is commonly as large and as tall as the corresponding species in those of Europe. I have measured several stocks which at 6 feet from the ground, were 15 or 16 feet in circumference, and which equalled the loftiest trees in stature."

Compared with this North Carolina specimen, the big chestnuts Michaux saw in the United States seem decidedly small. The one figured here (Fig. 9) appears to have been overlooked by all the botanists of the United States, none of whom mentions a specimen so large; but the figures in this case are given by professional lumbermen, who have had enough experience to know how trees are measured. In spite of Michaux's prediction, it appears that even at its maximum, the American species (*Castanea dentata*) does not attain such a large size as the European species (*Castanea sativa*); Elwes and Henry say (IV, p. 847) in regard to the English record:

"There is no doubt that the most celebrated, and perhaps the oldest planted tree in England, is the Tortworth chestnut. . . . Strutt says that in 1766 it measured 50 feet in circumference at 5 feet from the ground. . . . It was said by Sir R. Atkyns, in his 'History of Gloucestershire,' p. 413, to have been growing in King John's reign, and to have been '197 yards in compass.' At present it is by no means a beautiful tree, and so much of its original trunk is decayed that no measurement is of much value."

MAGNIFICENT ELMS

The elms of the eastern United States are among the largest shade trees, and the finest living specimen of this species (*Ulmus americana*) is probably the historic one at Wethersfield, Conn., reproduced in Fig. 10. Its history is described interestingly in a letter from Jared B. Standish, president of the Village Improvement Association. Wethersfield, it will be remembered, was settled in 1634, and is considered the first civil settlement in Connecticut. There seems to have been a wave of enthusiasm for civic beautification, twenty-five or fifty years after the founding, and it is believed that the Great Elm was planted at that time. In many of the pretty villages of the Connecticut River Valley, a row of elms through the middle of the entire village, with a road on each side, was established at that time.



WHAT IS LEFT OF A GIANT ELM

One of the purposes of the association's search for photographs of large trees was to arouse public interest in the subject and lead to the preservation of fine specimens. This photograph shows what is too often the fate of the most magnificent trees. It represents the remains of a swamp or white elm (*Ulmus americana*) near Morgantown, W. Va., measuring 33 feet in circumference. According to A. O. Woodfill of Morgantown, the photographer, the tree was deprived of its largest branches eight years ago, because many people sought shelter under the tree during storms, and the heavy "top hamper" was deemed unsafe. The trimming was apparently too severe, however, for the tree died, and is now nothing but a stump 50 feet high. It stands in black, sandy loam on the edge of a small swamp, surrounded by many small elms. (Fig. 11.)

In the early days of Wethersfield, open-air meetings were held under the Great Elm, and Charles Wesley delivered a sermon there in his tour through the Colonies in 1750.

In recent years the tree has been threatened, both by decay and by insects, but the Village Improvement Society has acted promptly in both cases, and the tree gives promise of ornamenting the village for many years to come. It is commonly believed by the inhabitants to be the largest elm in the country, and this appears to be correct. The association is in receipt of a photograph of a much larger elm of the same species from Morgantown, W. Va., but the latter specimen is now nothing more than a 50 foot stump, thanks to the indiscreet precaution taken eight years ago, of trimming it far more severely than it could endure.

Next to this, the finest elm reported is the "Rathbone Elm," a beautiful specimen located in Rathbone addition to Marietta, Ohio, which was photographed by H. P. Fischer of Marietta. It is 27 feet in circumference, 85 feet high, and in symmetry is quite the equal of the Connecticut specimen.

Both these specimens are larger than those which the literature cites. Elwes and Henry, for example, discussing the elm in New England, where it is particularly at home and particularly dear to the inhabitants, remark (VII, p. 1856):

"Though some of the historic trees mentioned by Emerson and other writers are now dead and decayed, there are still many splendid survivors of the original forest. Among these none is larger and more symmetrical than the Lancaster Elm in Massachusetts, which Professor Sargent showed me in May, 1904. It grows on deep sandy soil in the rich valley of the Nashua River, and measured 105 feet by 24 feet at 5 feet from the ground."

One of the interesting features of the contest has been the revelation of the number of trees in different localities which are locally reputed to be the biggest of the kind in the country. An elm at Somersworth, N. H., for instance, which is said to be considered by people in that section as the largest in the United States, proved to be only 14 feet 2 inches in circumference. By the side of such a specimen as the one lately killed at Morgantown, W. Va. (Fig. 11), this New Hampshire tree looks like a sapling, although in a grove of ordinary elms it would be most imposing in appearance.

THE SASSAFRAS RECORD

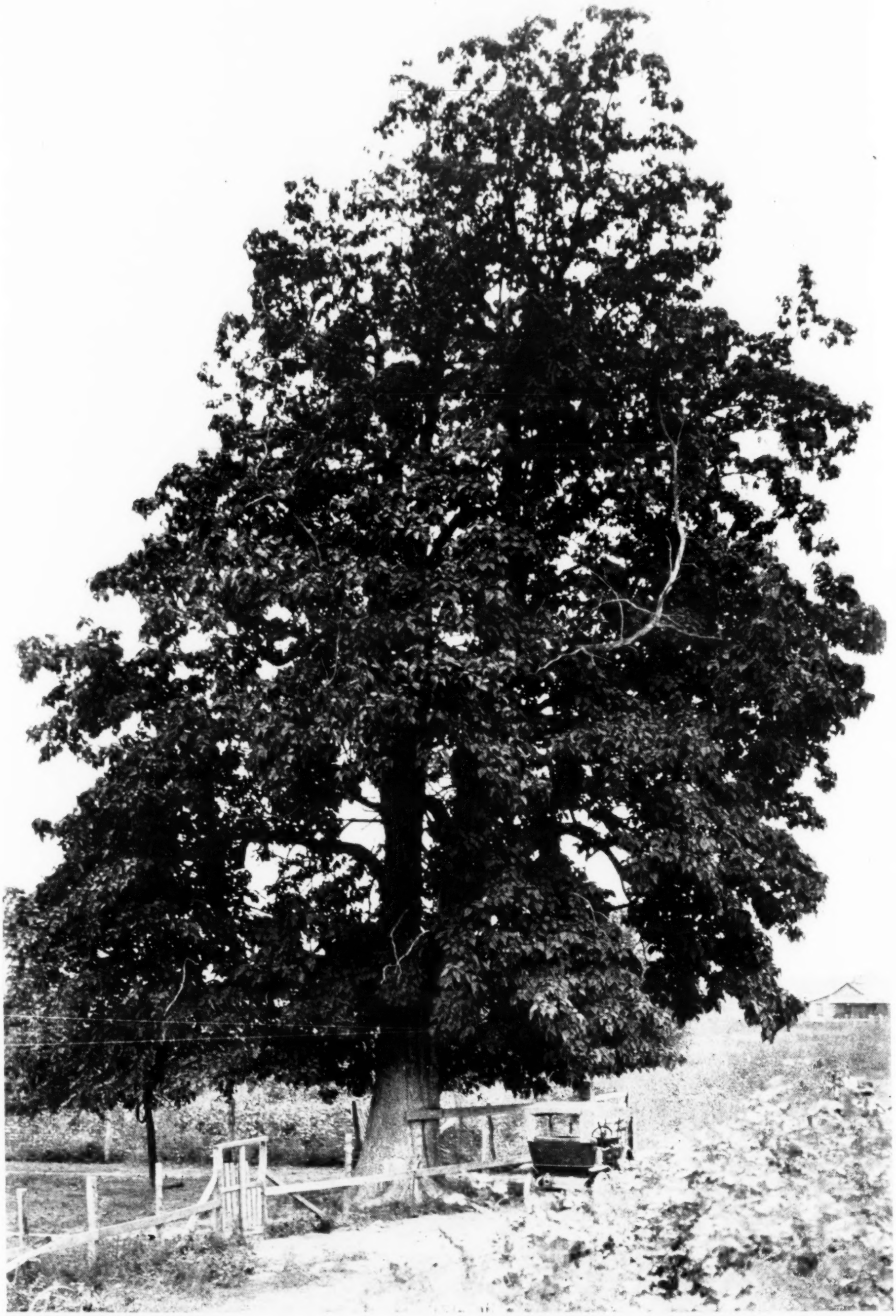
In many cases, the trees in which local pride expends itself are relatively insignificant specimens. An amusing instance of this is the sassafras, a tree which most people think of rather as a shrub, to be grubbed out of fields with much labor. Not long ago a town in Georgia made the modest announcement that it has the largest sassafras tree in the world—something over 7 feet in circumference. Jackson County, Ohio, immediately took up the challenge and ostentatiously produced a specimen of 7 feet in circumference at 3 feet from ground; whereupon Madison County, Ohio, jumped into the fray with a loud noise and a sassafras tree 9 feet 2 inches in circumference at that height, 8 feet 7 inches in girth at 5 feet from the ground.

This association has received from J. B. Corbin, of Juniata, Blair County, Pa., photographs of a beautiful sassafras 9 feet 7 inches in circumference at 7 feet from the ground; but all of these specimens are dwarfed by one at Horsham, Pa., 16 miles north of Philadelphia. This specimen was brought to light by W. H. Lamb, of the Forest Service, who secured photographs and description of it from Isaac Parry, of Horsham; its smallest girth, at 4 feet from the ground, is 15 feet 10 inches.

Some of these trees which are the particular objects of local pride have special points that are noteworthy, but do not bring them under the rules of this contest. Thus, many trees make up in height or spread what they lack in girth; but as girth is the only measurement which the ordinary person can take with accuracy, it seemed necessary to depend largely on this, in determining the merits of the trees submitted in this contest.

A LOUISIANA PECAN TREE

Although this is not the largest pecan tree in the country, it is perhaps surpassed by only one specimen, and its girth (19 feet 6 inches) is several inches above the maximum recorded by foresters. Its height is estimated at 150 feet. This pecan (*Hicoria pecan*) is located on the east bank of Cane River (Bermuda P. O.), Natchitoches Parish, La., and was photographed by Mayo S. Keator, East St. Louis, Ill. (Fig. 12.)



RECORD-BREAKING CATALPA

Many people think of *Catalpa speciosa* only as a quick-growing tree, planted in immense groves for the speedy production of fence posts and railroad ties. Michaux declared, "In these southern regions it frequently exceeds 50 feet in height, with a diameter from 18 to 24 inches." Later authorities allow it a maximum height of 120 feet and a maximum diameter of 4½ feet. Here is a specimen which, although only 75 feet high, has a girth of 16 feet. It is standing near Luxora, Ark., and was sent in by S. E. Simonson. (Fig. 13.)

This told against such trees as the famous Hooker Oak of Chico, Cal., photographs of which were submitted by half a dozen persons who will probably be quite surprised to learn that it is not the largest oak in North America. Its smallest circumference (3 feet above ground) is only 21 feet 8 inches. This is almost insignificant in comparison with the tree of the same species, illustrated in Fig. 8. The Hooker Oak, however, has a height of 105 feet and it is probably on this account that the famous English botanist, Sir Joseph Hooker, who measured it in 1872, pronounced it the largest oak in the world, as far as his encyclopedic knowledge extended. Dr. Charles Sprague Sargent of the Arnold Arboretum, Boston, who is perhaps the greatest authority on North American trees, is quoted as having said that he knows of no other tree in the United States which equals it in spread of branches. The outer circumference of the head is about 450 feet, and it has been calculated that, allowing 2 square feet of shade to each person, 7,885 people might find shelter from the sun under its branches.

Among smaller species of trees, one of the fine specimens sent in is the white birch (*Betula populifolia*) on Switzer Hill in the township of Athol, Worcester County, Mass., the smallest circumference of which is 12 feet 2 inches. This is considerably larger than the maximum ordinarily calculated for the white birch. The photograph was sent in by Philip R. Thayer, of Athol.

VIGOROUS HYBRIDS

As hybrid trees are notably rapid and vigorous growers, it is not surprising to find some of them in any list of big trees. Readers of the JOURNAL OF HEREDITY will remember the great James River Walnut described by Peter Bisset last year (Vol. V, p. 98). That supposed cross between the butternut (*Juglans cinerea*) and the Persian, improperly called English, walnut (*J. regia*) is 31 feet 3 inches in circumference at 4 feet from the ground, and is probably not much less than 200 years old. Some of the hybrid walnuts produced for commercial purposes in California during recent years have been reputed to be the fastest growing hard wood trees in the world, and notable among them is the Paradox Walnut, a cross between *J. regia*, the Persian (English) walnut, and a black walnut. One planted only about forty years ago at Yuba City, Cal., has now attained a circumference of 18 feet 7 inches at 4 feet from the ground, and a height of 100 feet. Photographs of it were submitted by H. H. Jacobs, of Santa Barbara, Cal. It is likely that this tree, which appears to be a natural, not an artificial, hybrid, is a cross between the Persian walnut and the black walnut of northern California, *Juglans californica*, var. *hindsi*.

It is perhaps worth noting that the name "Paradox" is the invention of the California plant breeder Luther Burbank, who applied it particularly to his own crosses. By common usage, however, it has now come to designate any cross between the Persian walnut and a black walnut, whether the latter be the California species (*J. californica*) or the common black walnut of the eastern forests, *J. nigra*. Such crosses are made very freely under naturai conditions, and in nurseries sometimes take place to such an extent as to be really troublesome to the horticulturist. The California black walnuts also cross readily with the eastern black walnut, the resultant hybrid being designated, after Burbank, as "Royal."

A TREE FAVORED BY LUMBERMEN **(See opposite page)**

The yellow poplar or tulip tree (*Liriodendron tulipifera*) is a favorite with lumbermen in the Southern States, because of the large amount of timber which can be cut from its trunk. As shown above, its growth habit is such as to allow the production of the maximum number of board feet. This specimen, which is considerably larger than the limit for the species set in the manuals of forest trees, grows on Reems Creek, N. C., and was photographed by John R. Hess, of Providence, R. I. He gives the height as 198 feet and the circumference, 4 feet above the ground, as 34 feet 6 inches. It is indisputably one of the finest tulip poplars in the United States. (Fig. 14.)

Fig. 14—Legend on opposite page.

Like many hybrids, these walnuts show a tendency to partial sterility, and are valuable for shade or timber rather than for nuts. In a few cases good nuts have been produced, but in general they are characterized by very light production, and the nuts are so hard-shelled and inferior as to have little commercial value.

Another magnificent nut tree, in its own species, is the pecan of Louisiana (Fig. 12), contributed by Mayo S. Keator, of East St. Louis. It stands near the east bank of a stream known as Cane River, Natchitoches Parish, La., and measures 19 feet 6 inches in circumference, with a spread of limbs of about 100 feet. It is far above the ordinary maximum of this species, and is exceeded, so far as this association has been able to learn, by only one specimen in the United States—an Oklahoma tree, which is credibly said to have a girth, breast high, of 23 feet. Some of these huge nut-bearing trees are decidedly valuable possessions: R. H. Kersey, of San Antonio, Texas, sends in the account of a pecan more than 5 feet in diameter, owned by Felix Heerman on the Medina River 13 miles from San Antonio, which produces as much as 2,000 pounds of nuts in a single season, and rarely fails to yield a good crop.

TALLEST TREE REPORTED

The magnificent yellow or tulip poplar of the Southern States (*Liriodendron tulipifera*), is, by reason of its habit of growth, so suitable for lumbering that it is difficult to save fine speimens. It is interesting, therefore, to know that the best one reported to this association (Fig. 14) is on private property where it is likely to be protected. This tree, contributed by John R. Hess, of Providence, R. I., stands in a "cove" near the bank of Reems Creek, not far from Craggy Mountain and about 17 miles from Asheville, N. C. It is stated to be 198 feet high and at 4 feet above ground has a circumference of 34 feet 6 inches. By the neighbors it is said to be the largest tree east of the Rocky Mountains, according to Mr. Hess. It may well be the largest tulip poplar, but cannot compete with some of the sycamores.

The soil where it stands is very rich, leaf mould being constantly washed down from the hillsides on its roots, as into a pocket, and this continuous fertilization may be partly responsible for the magnificent growth of the tree. It would be a matter of great difficulty, although of much interest and importance, to determine the relative share of heredity and environment in producing huge trees such as this contest has brought out. A long series of experiments might tell the story, and it would be well worth while for some one to get seeds from the best trees enumerated in this article, and grow them under a variety of conditions. Until this has been done, one can only proceed on the assumption, based on general considerations and experiments with smaller plants, that heredity is the fundamental factor but that proper environment is necessary to give heredity a chance to express itself.

Although the Michaux admired the tulip poplar, they seem to have seen no very fine specimens. André remarks[5] that his father found the best ones in Kentucky.

"He observed many of them in passing which appeared to be 15 or 16 feet in circumference and 3½ miles from Louisville, he measured one which, at 5 feet from the ground, was 22 feet 6 inches in circumference, and whose elevation he judged to be from 120 to 140 feet: the correctness of this estimate I have since had the opportunity of proving. Of all the trees of North America, with deciduous leaves, the Tulip Tree, next to the Buttonwood, attains the amplest dimensions; while the perfect straightness and uniform diameter of its trunk for upwards of 40 feet, the more regular disposition of its branches, and the greater richness of its foliage, give it a decided superiority over the buttonwood, and entitle it to be considered as one of the most magnificent vegetables of the temperate zone."

Elwes and Henry mention some larger

[5] Op. cit., Vol. II, p. 36.

specimens, but like the recent American writers on trees, they appear to have heard of none as large as the one here illustrated. They say[6]:

"The largest trees of this species, however, have been recorded by Professor R. Ridgway from southern Indiana and Illinois, near Mount Carmel, Ill. . . . Though the largest trees recorded by him have now been cut, reliable measurements were taken of a tulip tree which reached the astonishing height of 190 feet, exceeding that of any non-coniferous tree recorded in the temperate regions of the northern hemisphere. Another tree cut '8 miles east of Vincennes, was 8 feet across the top of the stump, which was solid to the center; the last cut was 63 feet from the first, and the trunk made 80,000 shingles.' The soil here is an exceedingly rich, deep alluvium, and the climate in summer very hot and moist.

"It is stated in *Garden and Forest*, 1897, p. 458, that at the Nashville exhibition a log of this tree was shown by the Nashville, Chattanooga and St. Louis R. R. Co., which measured 42 feet long, 10 feet 4 inches in diameter at the butt and 7 feet at the smaller end, containing 1,260 cubic feet of timber, and about 600 years old."

It is evident that the specimen illustrated in Fig. 14 outranks anything that has hitherto been reported. According to Mr. Hess, it has never before been photographed, and its publication herewith appears to establish a new record for this important species.

[6] Op. cit., Vol. I, p. 68.

DATA FORMERLY INADEQUATE

It is evident from the above records that the data on large trees in the United States, heretofore in the hands of men of science, was wholly inadequate. This was the principal reason why the association undertook to collect photographs, and it is a satisfaction to think that its purpose has been so well carried out, and that, thanks to the cooperation of hundreds of papers in giving publicity to the offer, and to the activity of 300 photographers who enlisted, the amount of available information on the subject has been notably increased. Although the prize offer is now terminated, it is the hope of the association that the expenditure of energy in this direction will not stop, but that tree lovers will be stimulated to more activity, in searching out specimens that can surpass those here recorded; and that they will also be spurred to take whatever steps are necessary to ensure the preservation of these magnificent members of the vegetable kingdom, some of which are certain to succumb to time, disease or greed each year, unless public sentiment interferes and demands their preservation.

Experimental Plant Breeding in Nebraska

Work in plant genetics at the Nebraska Agricultural Experiment Station has been largely concerned with maize and beans. The results obtained throw particularly bright light on the inheritance of quantitative characters such as size, which are, obviously, much less easily studied than qualitative characters such as color and pattern. The researches with maize, confirming those with a great deal of other material, indicate that a large number of separate factors are concerned in the production of any apparently simple quantitative character. In the single character of width of a grain of corn, for instance, it was decided that "Missouri dent and Tom Thumb pop probably differed by not over five factors and Missouri dent and California pop by perhaps as many as six factors influencing breadth of seeds." When it is remembered that each of these factors behaves independently in transmission, it will easily be understood how the progeny of crosses shows "almost every possible degree of width, thus giving rise to the condition known as blended inheritance," as distinguished from segregation, where the breadth of seed which characterized one or other of the parents would appear in full.

VALUE OF THE CONTEST

Photographs Received by American Genetic Association Throw Light on Many Interesting Problems—Awakening of Public Interest in Large Trees Will Be of Great Benefit to Science

W. H. Lamb
U. S. Forest Service, Washington, D. C.

THE interest of the forester and dendrologist centers upon several features in the contest of size among forest trees. Whatever may be the interests of the investigators in other departments of biology we are inclined to direct our attention to the ascertainment of what species reach the greatest size and of the maximum dimensions attained by every species. It is also of importance to consider the geographical location of these individuals with respect to the natural range of the tree.

The location and identity of the largest hardwood tree in the United States is a matter of considerable scientific and popular interest. Among coniferous trees the first place in size has been accorded the giant redwood of California. The size and age of these trees have long been a subject of great interest and have offered many opportunities for the free play of the imagination in correlating different stages of the development of one of these mammoth plants to different periods of ancient, medieval and modern history. Among broad-leaf trees, however, no one species stands forth as the colossus. The oaks, the chestnut, the sycamore, the yellow poplar, and a number of other broad-leaf trees all reach magnificent proportions. It is rather difficult to compare these trees in size. This is not only true because of the necessity of comparing different species but also on account of the variation in form among individuals of a single species.

Every tree has a form which it assumes under normal conditions. In some trees, especially among conifers, this form, deeply impressed for innumerable generations, has become fixed and hereditary to the extent that even when grown in abnormal conditions, it will assume the typical form. Very often, however, the special type of growth is not retained in a modified environment. It is true, especially among broad-leaf trees, that an immediate response to the advantage of more space results in a broad-headed and lateral growth which is not characteristic of the tree in the original forest where in dense stands a long, clear trunk is developed, and where lateral branches are suppressed.

IN THE PRIMEVAL FOREST

In the original hardwood forest of eastern United States the yellow poplar (*Liriodendron tulipifera*) and the sycamore (*Platanus occidentalis*) probably reached the greatest proportions. The yellow poplar developed a clear trunk and had a more uniform habit of branching than the sycamore; exceeded it in height and from the lumberman's standpoint was most desirable, since it would saw out more lumber; but the sycamore, although more irregular in habit, held first place in size on account of the massiveness of the branches, the primary limbs of a very large sycamore fully equaling an average forest tree in bulk.

The Pacific coast forest is made principally of coniferous trees, with broad-leaf trees occurring as undergrowth or as scattered individuals, and conspicuous only in valleys. The forest of eastern United States, containing about half as many coniferous tree species, has over four times as many broad-leaf species as are found in the western forest. It would be expected, therefore, that competition in size

among hardwood trees would be confined to eastern United States. But the original forest condition no longer prevails here. Clear lands and cultivated fields have largely supplanted the original forest growth. The giant trees which still remain are not the product of this new condition, however, but are the survivors of the original forest. Through accident, neglect and occasionally through early recognition of their value, they now occupy a position which has only been made permanent by the destruction of the surrounding forest. Soil and moisture conditions may now be considerably modified and may even be unfavorable for the growth of that species, but, notwithstanding, these patriarchs, vigorous even in age, may not have begun to exhibit the slightest deterioration. Standing alone these survivors occupy sites not unlike those of the isolated specimens of oak which are found growing naturally in the valleys of California. The age of some of these western oaks may be over 300 years. The isolated eastern trees may not have been in this condition for so long a time. As isolation appears to favor diameter growth the oaks of California are at no disadvantage in the contest for size among the hardwood trees.

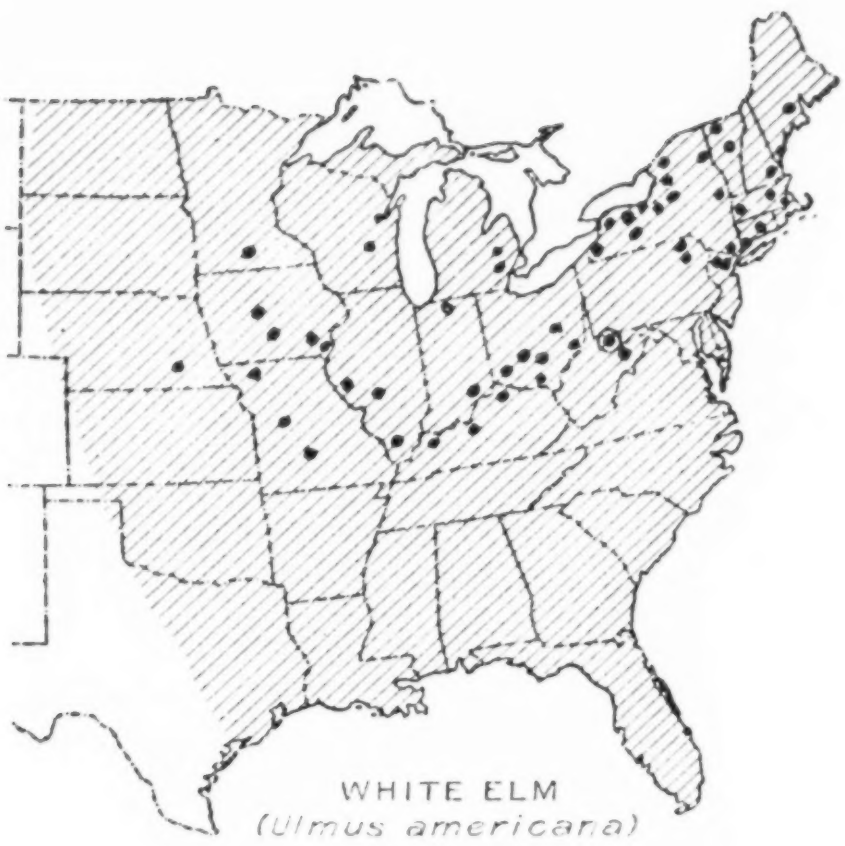
OLD AGE IN TREES

The largest individual of any tree species is generally taken by the forester as an index as to the maximum size attained by that species. In some instances fallen trees have been observed which have exceeded living specimens in size. Even in the present contest the largest specimen of elm submitted consists of only a dead trunk which, however, is still in an upright position. It is known that the life of this magnificent elm, having a circumference of 33 feet at 5 feet from the ground, was terminated by an outside factor, and that had it been protected, and if necessary assisted in the support of its massive branches, undoubtedly it would have grown on, reaching still greater proportions.

Exponents of the doctrine of indefinite longevity in trees maintain that they never die from old age or from causes analogous to those which determine the natural limit of animal life, but that they are destroyed by injury, disease, or other accidental influence. The theory is based upon the fact that a tree annually renews its growing parts. Each year the sapwood cylinder is increased on the outer side and on the inner side it is gradually being transformed into inactive heartwood. It is indeed evident that each species has an habitual period of death. The oak is notoriously long-lived. Willows and poplars have a brief existence. However, the early termination of the life of a tree may not be due to a natural death by old age, but to the fact that by the rapid growth, soft and fragile wood is produced which renders the species especially susceptible to decay or breakage. Moreover, it is likely that different species are susceptible to certain kinds of accidents. Plant disease, for example, favors some trees, and not others. A careful consideration of the causes of death in trees does not at all indicate that finally they must of necessity succumb to internal causes of destruction.

VALUE OF LARGE TREES

However, an appeal for the preservation of large trees is not based upon the scientific value which they may have in proving or disproving the doctrine of indefinite longevity. It would indeed be of greater value to such an investigation to experiment on woody plants of short life in order that results might be obtained within the period of observation of one investigator. The preservation of large trees yields scientific data of greater value in furnishing information as to the size attained by different species before they succumb to exterior or interior influences as the case may be. Unfortunately the same science which desires preservation of large trees also would dictate the felling of gigantic specimens in order to facilitate the inspection and study of the annual growth rings. Such arboricide would be most unfortunate. In the absence of superstition or peculiar beliefs which encourage the protection of vegetable matter we are apt to classify plants along with other natural objects. A



DISTRIBUTION OF THE LARGE TREES

Maps showing the range of six of the important timber trees represented in the contest, shaded. Dots represent location of the best specimens submitted, while dot surrounded by a circle indicates the point where the largest of them is situated. (Fig. 15.)

tree is a living thing. It enjoys freedom, suffers under confinement, reacts to poison, and according to late researches even exhibits phenomena in death not unlike that of the animal, although this is only evident by measurement with the most delicate and ingenious instruments. Trees live through many centuries and therefore become the oldest inhabitants of the earth. Their tremendous vitality, gigantic size and remarkable antiquity should inspire awe in the heart of the man who, with his feeble strength, small stature and short life does not hesitate to destroy the life of a patriarch which may have existed before the very dawn of botanical science. Only too often man is even willing to sacrifice a solitary monarch of the bygone forest in order to facilitate the cultivation of a field or to straighten a line of fence.

SENTIMENT ABOUT TREES

An appeal for the preservation of gigantic trees is not therefore made solely in the name of science. Preservation of these remarkable specimens will make possible valuable additions to our scientific knowledge, but the trees themselves in their beauty, utility and grandeur present an appeal not equalled by the interests of any scientific investigation. The possession of the largest individual of any species should be counted as a priceless treasure and should be cherished and protected beyond all other appurtenances of the estate on which it grows. These giants should be protected in every possible manner by their present owners whom they are destined to outlive, and legal provisions should be made to prevent their destruction by future owners of the land. A unique case is on record in Georgia where a tree was given legal possession of the ground upon which it grew. This tree is perhaps the only one in the world which holds a deed to itself and the surrounding ground. Nearly a century ago Col. W. H. Jackson, son of Governor Jackson and father of Chief Justice Jackson of the Georgia Supreme Court, placed the deed on record, in which he gave the tree entire possession of itself, together with 8 feet of ground on all sides.

This contest of the American Genetic Association confirms the fact that the sycamore is our largest hardwood tree. Data of scientific value are also presented in the case of many other species. Two introduced trees, Lombardy poplar and English walnut, are of special interest. The former was submitted from a region that was one time included in the treeless desert of the Middle West. Growing at Arapahoe, Neb., this European poplar has reached a circumference of 9 feet 10 inches and a height of about 100 feet within a period of thirty-two years. A specimen of white elm from Milford, Neb., reached a circumference of 10 feet, a height of 32 feet and a spread of 67 feet in about sixty-two years. An interesting competitor also is a specimen of hardy catalpa from Arkansas having a circumference of 20 feet at 3 feet from the ground and a height of 75 feet. A number of specimens exceeded the dimensions generally regarded as a maximum for that species.

PROBLEMS OF DISTRIBUTION

The student of forest geography will be interested in the location of the trees submitted with reference to the geographical distribution of the species. In the discussion of the scientific value of the prize contest it is not possible to go into great detail. However, it has been possible, even in the brief time available, to present maps of six species which have been selected on account of their importance as forest trees, as well as the large number of contestants among these species which are included. The location of the largest individual, whose size is given in the following table, is indicated by a small circle:

Common Name	Scientific Name	Location	Circumference
White elm	*Ulmus americana*	Morgantown, W. Va.	33 ft.
White oak	*Quercus alba*	Atwood, Ind.	21 ft.
Sycamore	*Platanus occidentalis*	Worthington, Ind.	42¼ ft.
Chestnut	*Castanea dentata*	Crestmont, N. C.	33¼ ft.
Black walnut	*Juglans nigra*	Hanover Neck, N. J.	24 ft.
Yellow poplar	*Liriodendron tulipifera*	Asheville, N. C.	34½ ft.

In the case of white oak the tree selected was merely identified by the contestant as "oak," but undoubtedly should be referred to *Quercus alba*. A white oak larger than this has been cut for lumber near Wilmington, Ohio. This tree measured 23 feet in circumference and was found to be 500 years of age.[1] Before drawing scientific conclusions from these data, account must be taken of the fact that the specimens are not necessarily the largest individuals of their kind, also it may be that the territory included by the different localities may be influenced by the channels through which the contest was brought to public notice. However, the absence of large trees from the western limit of the range of the species may be regarded as significant and, of course, should be viewed in the light of our knowledge of the fact that eastern hardwoods are migrating into the treeless prairie region. The occurrence of large specimens at the very limit of growth would tend to indicate either that the range was receding or else that there occurs at that place a sudden modification of conditions favorable to the growth of the species, or that the species is confronted by some physical or other barriers to its range extension.

The location of the largest elm in West Virginia is of interest. The New England States have long been regarded as producing the most remarkable examples of this species. It is not improbable that a specimen may be discovered which will restore the prestige of the New England elm. The location of the largest chestnut and yellow poplar in North Carolina is not unexpected, as some of the most magnificent stands of hardwood trees are found in the Southern Appalachians. The forests here are in virgin condition and this operates to the advantage of big trees in that they have been spared from the woodman's axe and to their disadvantage in that if left standing, unsurrounded by the crowding forest, they will attain greater lateral dimensions. The location of the large black walnut in New Jersey is of interest. The nearness of the eastern limit of its range, however, is not significant on account of the physical barrier of the Atlantic Ocean.

It must be understood that this article, to the preparation of which only a few hours could be given, can do no more than merely hint at the results of scientific value which will flow from the American Genetic Association's contest. In connection with the work of this office on the geographical distribution of trees many local problems will arise which can be more readily solved by reference to the photographs and letters which have been very kindly made available for reference through the courtesy of the association, than by any other way. The ultimate scientific value of these data, however, depends upon whether or not public interest in big trees ceases with the conclusion of this contest. As a basis for the actual determination of the largest individual among hardwood trees, and of the largest representative of every tree species, the data secured will prove of immense value. If readers will be good enough to continue to call the American Genetic Association's attention to the occurrence of notable trees, giving all available information on their history, condition and size, they will be rendering valuable assistance in our pursuance of these scientific investigations.

[1] An interesting account of this tree with data on its life history and the variation in the number of annual rings to the inch from the center to the outer surface is to be found in the National Coopers Journal, Philadelphia, July, 1909, pp. 1, 2.

Plant Breeding in South Carolina

Practical work is the rule at the South Carolina Agricultural Experiment Station, including breeding new varieties of cotton resistant to cotton wilt, breeding cotton for prolificness and a longer, stronger staple, breeding new types of rotundifolia grapes and apples.

ROSA HUGONIS

A New Hardy, Yellow Rose from China

DAVID FAIRCHILD

IF YOU see a particularly beautiful picture hanging in a friend's house your first question is, "Who painted it?", yet how few of the people who visit a rose garden and admire the beauties of color and form ever realize that practically all of our cultivated double roses are almost as much the result of man's work as a picture is. These living forms have arisen from the greatest artificial mixing of species which man has been able to bring about by the process of hybridization.

Wild roses from all over the world have entered into their ancestry and made them what they are, so that to a rosarian the history of a rose's ancestry is quite as fascinating as is a family tree to a student of genealogy.

To create a rose which will delight thousands of people must be as keen and wonderful a pleasure as intellectual man can enjoy; long after he has crumbled to dust generations of beautiful women, happy children, old men and young lovers will bury their faces in its petals and forget for the moment all else but its beauty.

Next to this pleasure, perhaps, is the enjoyment that comes from finding a wild rose in some far off land where it blooms unseen by cultivated eyes, and knowing that it will become the admired and loved garden treasure of a whole great civilized country.

I do not know if Father Hugo Scallan still lives or not, nor whether his life was a happy one, but if he is alive it would surely give him the keenest kind of pleasure to watch the career of a yellow rose which he found in China.

In 1899 he sent seeds of this rose to the British Museum, the authorities there sent it to the Royal Botanic Gardens at Kew—that great institution from which so many things of value have come into cultivation; and from Kew we obtained seeds for the United States. Very early each spring it blooms and it is yearly attracting the attention and arousing the enthusiasm of more and more flower-loving Americans.

Rosa hugonis is the name that has been given to this beautiful yellow rose that deserves a place in every dooryard in America. It is the earliest blooming of almost all the roses and earlier than any other yellow rose. It is of a lovely shade of yellow, is delicately perfumed and produces its single flowers in such profusion, as almost to conceal the plant. It is perfectly hardy, not being injured by —22° F., which cannot be said of most of the other yellow roses.

At the Arnold Aboretum near Boston Professor Sargent says it is perfectly hardy and free flowering and "is certainly one of the most valuable single roses which has lately been introduced into gardens."[1]

It seems entirely fitting that to Dr. W. H. Van Fleet, the originator of the Silver Moon and the Van Fleet roses, those masterpieces of rose hybridization, should be given the credit for insisting, as long ago as 1907, that *Rosa hugonis* be introduced into America for the dooryards of American homes and for the use of American rose hybridizers. It was his insistence that led the Department of Agriculture to import it from Kew Gardens.

In the photograph *Rosa hugonis* is shown as espaliered against the wall of the writer's house at North Chevy Chase, Md. Every spring, before anything but the Japanese flowering apricots (*Prunus mume*) and the single flowering Japanese cherries are in bloom, it has delighted all who have

[1] Arnold Aboretum, Harvard University Bulletin of Information, New Series, Vol. I, No. 5, p. 20.

ROSA HUGONIS, FATHER HUGO SCALLAN'S ROSE

This is not of so deep a shade of yellow as Harrison's yellow or the Persian yellow rose, but the bush seems to be perfectly hardy and it blooms with an abandon quite foreign to either of the others. Photograph of a bush espaliered against the house, In the Woods, North Chevy Chase. Photo by Crandall. (Fig. 16.)

A NEW YELLOW ROSE FOR THE PLANT BREEDER.

Rosa hugonis trained on a wall trellis at In The Woods, North Chevy Chase, Md. One of the earliest of all the roses and earlier than any other yellow rose. (Fig. 17.)

seen it, but even in winter it is ornamental because of its red-brown stems, red thorns and its picturesque growth.

When not trained against a wall it grows to a height of about 5 feet and its stems are clothed with numerous slender spines which are bright red on the straight young shoots. Its leaves are thin and delicate and so far as the writer's observations go it is not subject to the rose spot disease which turns briar rose bushes, such as Lord and Lady Penzance, into long unsightly masses of naked stems before the summer is over.

This lovely yellow rose has one small drawback. It does not seem to grow easily from cuttings or slips. It seeds freely, however, and can be raised in this way even should a quicker way not be discovered.

To those who are interested in roses it may be a matter of satisfaction to know, that the breeding of this rose with others is now going on here in America, and the appearance of some new descendant of Father Hugo Scallan's rose is probably merely a matter of time.

NEW PUBLICATIONS

THE MUTATION FACTOR IN EVOLUTION, with Particular Reference to Oenothera. R. Ruggles Gates, Ph. D., F. L. S. Pp. xiv+353, 114 figs., map and bibliography. London, Macmillan & Co., Ltd., 1915. Price 10*s.* net.

There is little left unsaid on the subject of Evening Primrose mutations, after Dr. Gates has finished with the subject. It has attracted an immense amount of attention in the last score of years—Dr. Gates' bibliography contains more than 450 entries—and the author has performed a real service by digesting the literature, to which his own contributions have been notable, and publishing it in this form. A considerable part of the book is, naturally, devoted to proving that there really is such a thing as a mutation. To those who have contended that the supposed mutations were merely the effects of hybridity, Dr. Gates answers that the cytological evidence disproves this; and the finding of a specimen of *Oenothera lamarckiana* which was collected by Michaux in America late in the eighteenth century shows that this chief of the mutating species is a real one, and not merely the hybrid product of some European garden. Dr. Gates discusses mutants in other plants, and animals, and concludes with a general theory of mutation, and a discussion of the significance of mutation in evolution.

SOCIETAL EVOLUTION, by Albert Galloway Keller. Pp. ix+338, price $1.50. New York, the Macmillan Co., 66 Fifth Avenue, 1915.

It is still a disputed point among sociologists, whether the mechanism of biological evolution—variation, heredity, selection, adaptation—is also the mechanism of the evolution of society. The distinguished professor of the science of society at Yale believes that it is, and has written this very readable, interesting and suggestive book to prove it, basing himself solidly on Darwinian foundations. As the evolution of society depends on changes in popular customs or mores, and the success of the eugenics program equally depends on a change in the mores, Professor Keller's extended and sympathetic discussion of eugenics must be of great interest to every genetist. He points out that the maintenance mores, those which are principally economic in character, are much more easily changed than any others, and holds that the easiest route for eugenic propaganda is along this line. "Negative eugenics" is therefore most likely to be successfully put into practice, because it touches closely upon the struggle for a living. As to the immediate practicability of positive eugenics he does not show great enthusiasm, and it is likely that most eugenists will find their dreams a little less rosy, after reading his able review of the case.